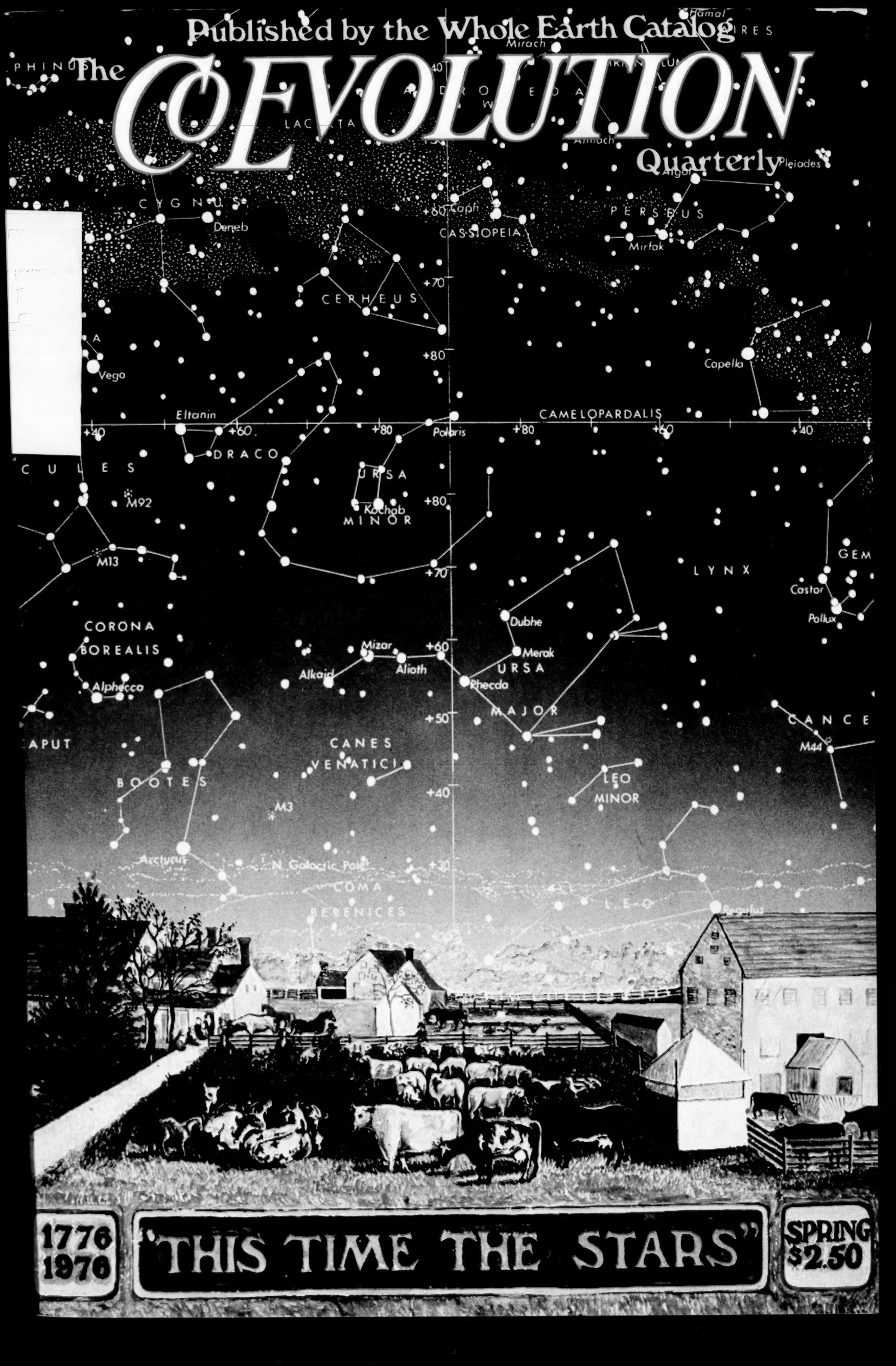
Published by the Whole Earth Catalog

The CoEVOLUTION Quarterly

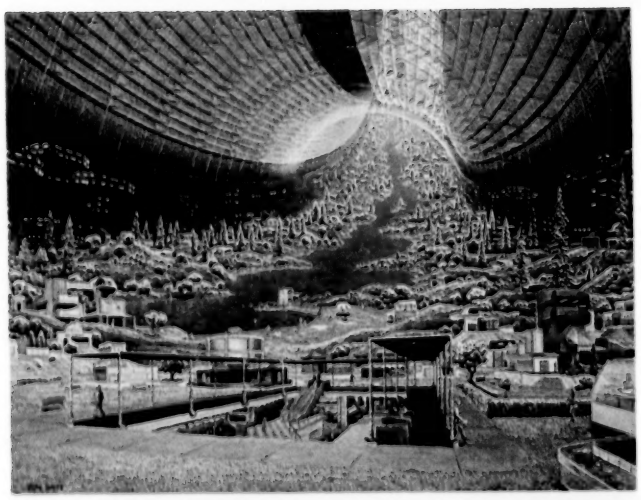


1776
1976

"THIS TIME THE STARS"

SPRING
$2.50

Model I Space Colony as designed by NASA-Ames Summer Study, 1975.



Cover

The front and back covers are by S.N. Durkee, who did the Winter '74 CQ (eagle) cover. Like every other graphic artist we know, he's enthusiastic about Space Colonies.

The inside front cover, by Don Davis, shows the "Stanford Torus" – two Model I Space Colonies for 10,000 inhabitants as designed by the NASA-Ames Summer Study group last summer. Each wheel is about 2000 yards across, so that rotation at 1 rpm provides 1g of "gravity" at the rim. Around the outside is a yard of rock slag for shield against cosmic radiation (10 roentgen/yr). Sunlight is reflected into the wheel by a 1500-yard flat mirror maintained in position by occasionally fired gas jets. As sunlight is reflected into the colony it is cleansed of cosmic rays (which don't reflect) by bouncing through the "chevron shielding" of the skylights. 18 miles away is a second colony. At upper right is a Peter Glaser-style microwave beam-down solar collector manufactured at the colony for use by Earth. At lower left a space tug brings a net load of lunar material for processing by the zero-gravity factory at the end of the long rigid colony boom. We're at the Lagrangian point L-4. The Moon is to the left, Earth right, 60° apart.

The Blackfoot couple above was photographed by Edward S. Curtis early in this century.

–SB

Space Colonies

4-5 Summary of Gerard O'Neill's idea ▪ **Is Balance Really Possible Where Even Gravity Is Manufactured? (Comments on O'Neill's Space Colonies)**
6 *Ken Kesey* ▪ *Russell Schweickart* ▪ *Lewis Mumford*
7-8 *Lynn Margulis* ▪ *Richard Raymond* ▪ The real backers ▪ *Dean Fleming* ▪ *Wendell Berry*
10 *Wilson Clark* ▪ Space for peace ▪ *E.F. Schumacher* ▪ *Stephanie Mills*
11-12 *Steve Durkee* ▪ Extra energy ▪ *Steve Baer* ▪ The SF vote *Dennis Meadows*
13-14 *Stanley Marsh III* ▪ Sufficient error ▪ *Paul and Anne Ehrlich* ▪ Pioneer ▪ Down the road
15-16 *Ernest Callenbach* ▪ *Carl Sagan* ▪ Rather ▪ *William Irwin Thompson* ▪ *George Wald*
17-21 *David Brower* ▪ *Michael Phillips* ▪ *Ant Farm* ▪ *John Todd*
22 *Brother David Steindl-Rast* ▪ Info isn't heavy
23-24 Planet parenthood ▪ *Richard Brautigan* ▪ Juvenile space ▪ *Peter Warshall* ▪ Landscape and tools
25-26 Phosphate! ▪ Cycles & pollution ▪ Biology first ▪ L-5 News ▪ Arab Space Program
27-29 *Anne Norcia* ▪ *Marc Le Brun* ▪ *Garrett Hardin* ▪ *R. Buckminster Fuller* ▪ Seed
30-34 *Paolo Soleri* ▪ *Julia Brand* ▪ Better foolishness
35-42 *David Shetzline* ▪ Partial atmospheric pressure ▪ *John Holt* ▪ Technical debate
43-44 Behind the question ▪ *Erik Eckholm* ▪ Margalef, civilization & space
45-46 Hot Gaia ▪ *Gary Snyder* ▪ Metallurgical paradise ▪ *Hazel Henderson*
47 Space war ▪ *Anne Waldman* ▪ *Vine Deloria, Jr.* ▪ Brazil's space colony
48 *Gurney Norman* ▪ Daughter ▪ Investment space ▪ Compiler ▪ Allure ▪ National Space Institute
50-53 *Gerard O'Neill* ▪ *Stewart Brand*
54-65 **The New Alchemists** *by John Todd*
66-71 **Space Colonies, Ethics, and People** *by J. Peter Vajk*
72-79 **Space colonies should keep away from the government for a while** Astronaut *Russell Schweickart* on the phone

Understanding Whole Systems

80 General Systemantics ▪ Where Are The Earth's Erogenous Zones?
81 U.S. Photo Murals ▪ Losing Ground ▪ World Game, 1976 ▪ World Model
82-84 **Prayer Breakfast** *by Gregory Bateson and Governor Jerry Brown*
85 Capitalism and Material Life ▪ The Elements ▪ Le Sauvage
86-87 **Four New Poems** *by Gary Snyder*
88-90 **Sociobiology** *by Peter Warshall*
90-91 Isak Dinesen ▪ Its the water – and a lot more ▪ Oaks and the sweet smell of sex
91 A Coevolutionary game: Feeding the Masses ▪ Coevolution takes TIME

Land Use

92-93 The Postage Stamp Garden Book ▪ Mulch Books ▪ Comfrey Report
93 Vegetable Crops ▪ Organic Small Farming ▪ Fertility Pastures and Cover Crops
94-95 The Earth Manual ▪ Rybczynski & Warshall on shit management ▪ Wildflowers and Weeds

Soft Technology

96 Homemade Windmills of Nebraska ▪ Other Homes and Garbage
97 Farallones Institute ▪ Display wattmeter ▪ Energy Earth and Everyone ▪ Kilowatt Counter
98 Solar Energy Thermal Processes ▪ Solar Energy Handbook ▪ Solar Pond
98 Solar Energized Food Dehydrator ▪ Solar Test Facility
99 Solar Directory ▪ VW prime mover ▪ Devcon ▪ The Procedure Handbook of Arc Welding
100-105 **MORE Highly-Evolved Toolbox** *by J. Baldwin*

The COEVOLUTION Quarterly Spring 1976

Craft

106-107 By Shaker Hands ▪ Health Hazards Manual for Artists ▪ Colorado Fleece Company
107 Art Needlework Industries ▪ Star Wool Stores ▪ Fabric Printing: Screen Method

Shelter

108 Illustrated Housebuilding ▪ Do-It-Yourself Plumbing ▪ Dome Notes

Community

109 Lehman Hardware Company ▪ Moonshiners Manual ▪ Practical Self Sufficiency
110 A Barefoot Doctor's Manual ▪ New Woman's Survival Sourcebook
111 Follow-up on the "no jelly" diaphragm
111 What Do We Use for Lifeboats When the Ship Goes Down? ▪ Talc-asbestos hazard
112 From Huey Newton in Cuba ▪ And There Was Light ▪ The Book of Tofu
113 The Country of the Pointed Firs
114-117 **Great Creatures Throughout History and How They Grew** *by Dan O'Neill*

Nomadics

118-119 Canada Bike ▪ Bike mouth & superbike ▪ King of the Road ▪ Total bike access
120-121 Frisbee ▪ Economy Driving ▪ Le Truck ▪ Without Wheels
122 Alden Shell ▪ Surveying Small Craft ▪ Boat Building With Plywood
123 Heavy Weather Sailing ▪ Sager Weathercaster ▪ Good grub(s)
124 The Art of Bodysurfing ▪ Hang Flight ▪ 1976 Charter Flight Directory
125 Structure Fishing ▪ Net ▪ American Caves and Caving

Communications

126-127 Boycott the Metric System ▪ On Machine Intelligence ▪ Computer Chess ▪ Calculus Primer
128 BYTE Magazine ▪ Hobbyist computer suppliers and clubs
129 Digital Design with Standard MSI and LSI ▪ Computers in the 1980s
130 Computer structures ▪ Fractured anatomy ▪ Peter Kagan and the Wind ▪ The First Seven Days

Learning

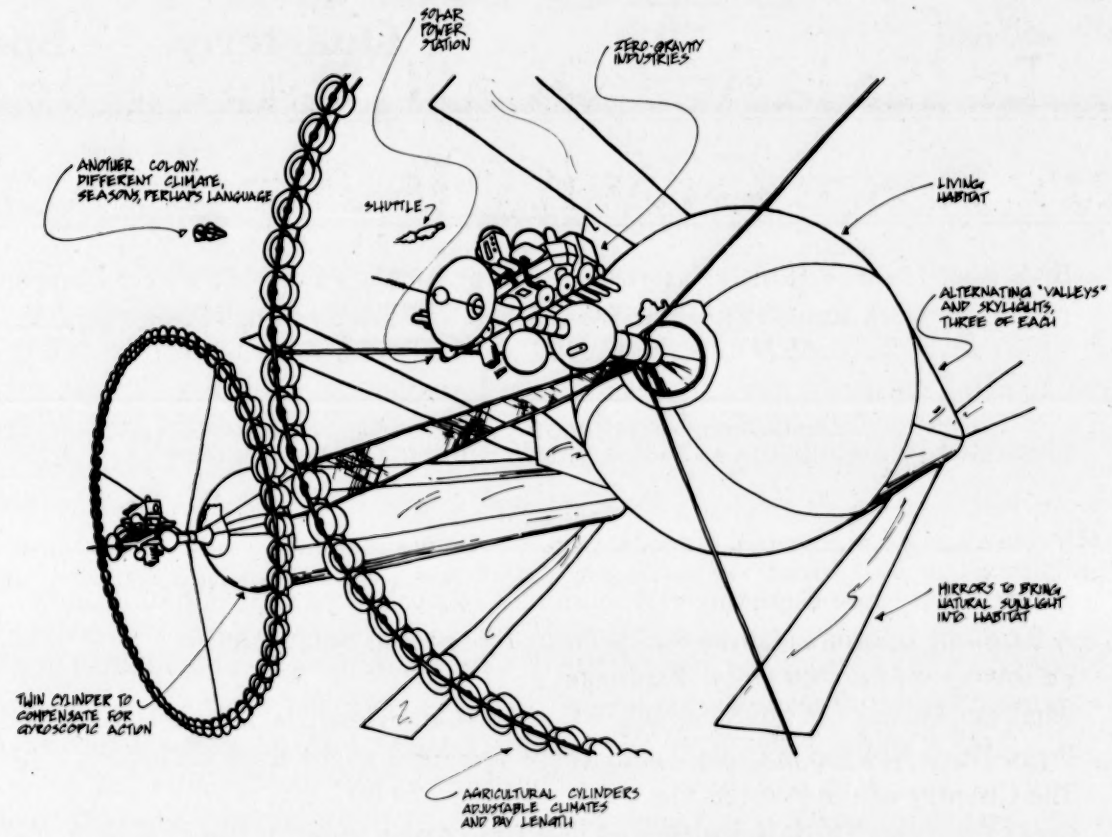
131 Joni Mitchell ▪ Cricket ▪ Read For Your Life
132-139 **Take As Directed** *by Ron Jones*
140-142 From Sad to Glad ▪ A Rating of Graduate Programs
142 Barron's Guide to Medical, Dental, and Allied Health Science Careers
142 CPC Salary Survey ▪ More on Grassroots Distribution

Business

143 CQ balance sheet ▪ CQ financial picture ▪ Subscription price going up ▪ Or Whole Earth
144 Gossip ▪ Patrons ▪ Credits

The CoEvolution Quarterly ▪ Issue No. 9 ▪ March 20, 1976. *Published quarterly by POINT, a California non-profit corporation. Office of publication (editorial and subscription): Box 428, Sausalito, CA 94965. Subscriptions: $6 per year. Inquire for international air rates. Second-class postage paid at Sausalito, CA and at additional mailing office.* **Postmaster:** *Send Form 3579 to Box 428, Sausalito, CA 94965. Forwarding postage guaranteed.* **Copyright © 1976 by POINT.** *All rights reserved.*

Space Colonies



Summary

of the 26 pages on Space Colonies in the Fall '75 CQ *to which the following 76 pages of comments respond.*

Gerard O'Neill, 48, is a notable high-energy physicist — he developed the particle storage rings that have become standard on nuclear accelerators. In 1969 he posed a special question to a special seminar of his freshman physics students at Princeton, **"Is the surface of a planet really the right place for an expanding technological civilization?"**

They and he concluded that, no, free space would be better — richer energy domain (sunlight pouring past at ten times the strength of Earth sunlight), fine manufacturing materials available in the Moon and asteroids, many advantages of zero gravity, and lots of room. When they addressed the engineering of building an Earth-like environment, they found that many of the design problems solved each other.

The pinnacle of their vision is the behemoth Space Colony Model III, home of 1,000,000 inhabitants, the result by about 2000 AD of a "bootstrap" sequence of successively larger space manufacturing facilities. The first step, Model I, would cost $100 billion, be ready in 15 years, house 10,000 people, and rapidly start paying for itself by constructing Satellite Solar Power Stations (SSPS) for micro-wave beam-down of energy from low-Earth-orbit — replacing nuclear and fossil fuel use on Earth.

The later colony, Model III, would be 6¼ miles long by 1¼ miles in diameter (across each of the two counter-rotating cylinders). The cylinders would rotate at a rate to provide centrifugal force equivalent to Earth gravity (1 g). Each cylinder would consist of three valleys, interspersed with three enormous windows with huge mirrors to reflect in sunlight. Every inhabitant would have something like five rural acres in this space terrarium. A vessel that big would have blue sky and weather.

98% of the material of the colonies would come from the Moon, taking advantage of the high metal, glass, and oxygen content of lunar "soil." Hydrogen, nitrogen, and other essentials for life would have to be hauled up from Earth. With 1/20 of Earth's gravity on the Moon, and no atmosphere, it would be possible to propel lunar material off the Moon by means of a "mass-driver" — magnetically controlled buckets flinging Moon chunks toward the colony site. The entire construction of Model I would leave a mined hole only 7 yards by 200 yards by 200 yards. O'Neill claims that the whole Space Colony project can be done with present technology.

The site, usually called "L-5," is one of the two stable gravitational points in the Earth-Moon system. The Lagrangian libration points, L-4 and L-5, precede and follow the Moon in Orbit around the Earth (see diagram). They are Sargasso Seas of space, where things accumulate.

As the bootstrap process continues, O'Neill foresees each colony manufacturing more colonies, and each of them making themselves as attractive as possible to draw colonists from Earth. Travel and communications between colonies would be very easy, but O'Neill expects that they would become increasingly diverse, comprising different Earth groups, different ideas, and setting forth on different missions to the asteroids, other planets, and even out of the solar system entirely.

This year, 1975-76, the Space Colonies are beginning to be a public issue. O'Neill has testified before a House Committee and a Senate Committee. NASA (National Aeronautics and Space Administration) has done studies on the scheme and increased their interest. One Presidential runner, Morris Udall, has already expressed interest. Since O'Neill's original article in Physics Today *in 1974, there have been major articles in* The New Scientist, Science, The New York Times Magazine, Saturday Review, Harpers, The Smithsonian, *and others.*

Everything that has appeared in print has been favorable. Till now.

—SB

Is Balance Really Possible Where Even Gravity Is Manufactured?

COMMENTS ON O'NEILL'S SPACE COLONIES

Illustrations by G. Russ Youngreen, Jay Kinney, Anne Norcia, and Larry Todd

Something about O'Neill's dream has cut deep. Nothing we've run in The CQ *has brought so much response or opinions so fierce and unpredictable and at times ambivalent.*

It seems to be a paradigmatic question to ask if we should move massively into Space. In addressing that we're addressing our most fundamental conflicting perceptions of ourself, of the planetary civilization we've got under way. From the perspective of Space Colonies everything looks different. Choices we've already made have to be made again, because changed context changes content. Artificial vs. Natural, Let vs. Control, Local vs. Centralized, Dream vs. Obey – all are re-jumbled. And Space Colonies aren't even really new. That's part of their force – they're so damned inherent in what we've been about for so long.

But the shift seems enormous, and terrifying or inspiring to scale. Hello, stars. Goodbye, Earth? Is this the longed-for metamorphosis, our brilliant wings at last, or the most poisonous of panaceas?

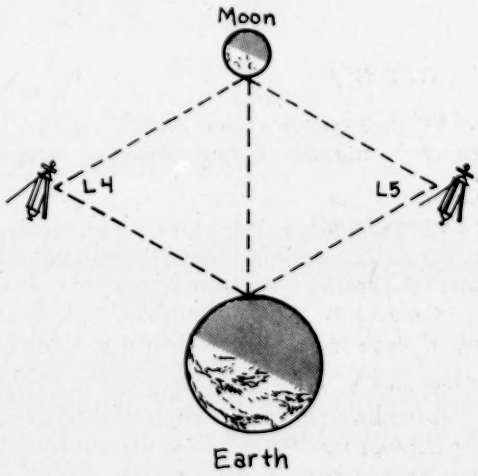
I've done a couple of things to help drive the question as deep as I could, for most original yield. Along with the presentation in the Fall '75 CQ *of several angles on O'Neill's vision I stated all of my enthusiasm for the project and few of my misgivings – the usual brainstorm approach. I was partially aiming at environmentalists, including me, who have become too predictable of late, too smug, certain, convergent, uninquiring and unimaginative. We have come to love our famous problems (population, inequity, technology, etc.) and would feel meaningless if they went away. That's a lousy design posture.*

This winter I wrote personally to a number of notable people inviting their comments (which follow beginning overleaf). I said I would pay them $30 and print whatever they sent, and would they hold it please to 1,000 words (some didn't). Response was amazing; at least half of the list wrote something – divided almost equally pro and con, somewhat more on the con. For this I'm grateful. Space Colony planning is going ahead full-bore and one-eyed. It badly needs intelligent criticism.

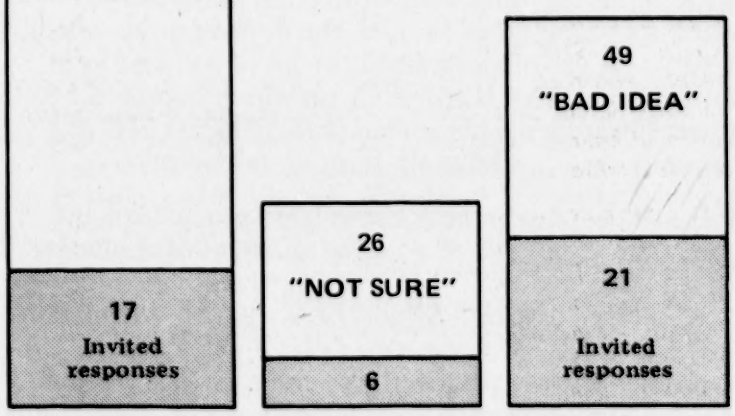
The readers at large were invited to remark, telling whether they think Space Colonies are a good or bad idea, whether they'll gladly emigrate, and why. 170 people responded, which seems a lot for our modest circulation (17,000 or so). Results have been tabulated in the graph. Excerpts from the readers' letters are scattered through the following pages (they were paid $10 each).

There's one thing within the response perhaps worth mentioning. The colleges these days are having another Silent Generation like the one I was in during the late '50's. Nothing seems to make them jump – not politics, drugs, heroes, projects, or any special sense of themselves as a generation. The 122 people who wrote us enthusiastically approving of Space Colonies – and most of them wanting to go – are nearly all college students.

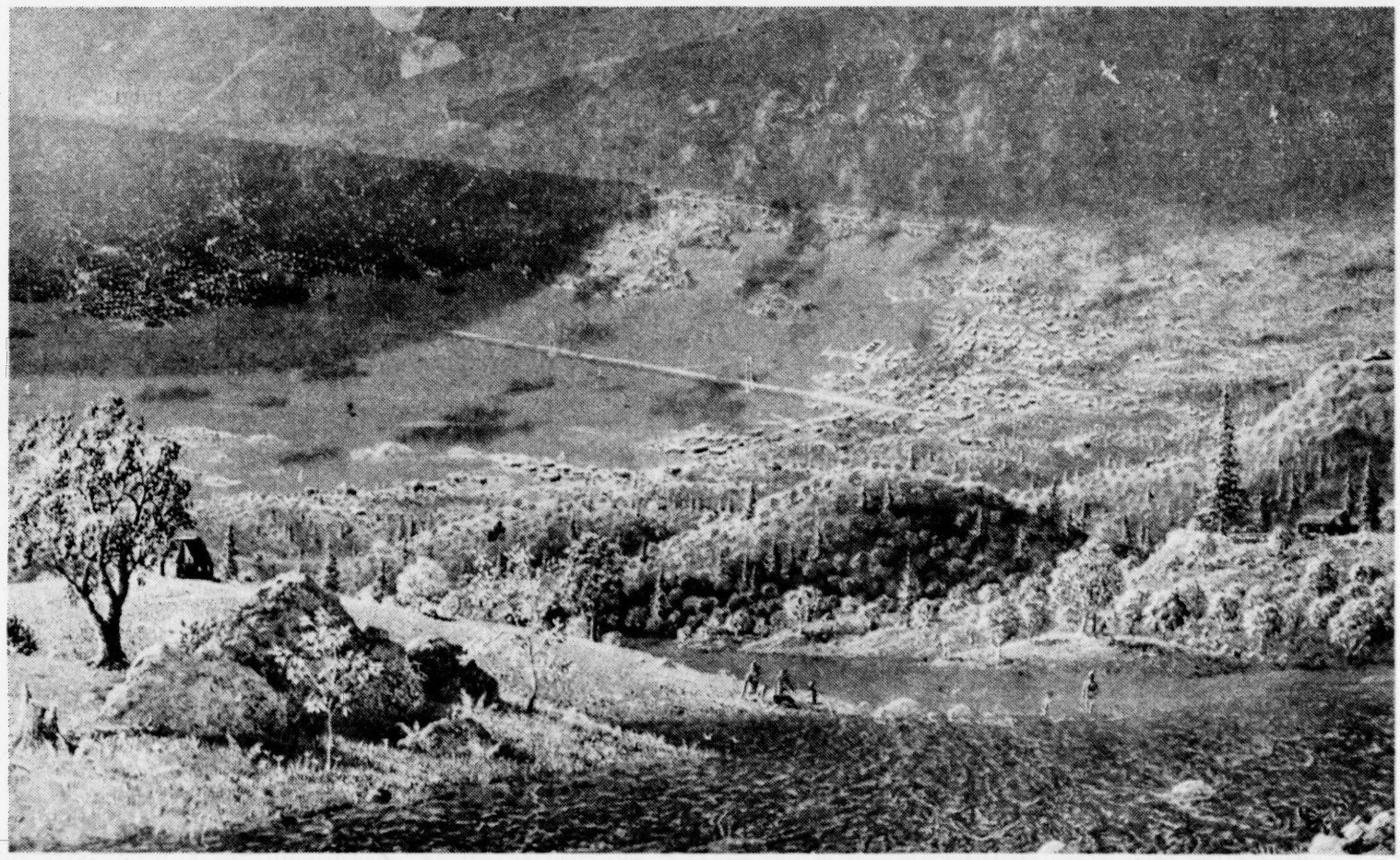
–SB



Location of Lagrange points L4 and L5.



Response to Space Colony questionnaire by readers and invited commentators. Of the 139 who liked the idea, 104 said they were ready to go aboard. Women accounted for 13 yesses, 7 no's, and 1 maybe. The most universally favorable group was artists.



Inside a Model III Space Colony. This painting by Don Davis, which we used on the cover of the Fall '75 **CQ**, *has aroused as much ire as admiration. Viewing from a colony end-cap mountain it depicts weather, a running river, mature ecosystem, "night" falling, and agricultural pods outside the skylight. Real Space Colonies may never be so nice, may never be at all, or may be much nicer.*

KEN KESEY

Novelist, pioneer, author of **One Flew Over the Cuckoo's Nest; Sometimes a Great Notion**

A lot of people who want to get into space never got into the earth. It's James Bond. It's a turning away from the juiciness of stuff. That's something that's lost its appeal for me.

RUSSELL SCHWEICKART

NASA astronaut (Spacewalk, Apollo 9). *See also interview on p. 72.*

Gerry O'Neill is my hero. At a time when hair-shirting is the style and immediate utility the password to success, O'Neill dares to open the door again to man's destiny. A yes of fresh air in the no of a closed and stuffy room. This is the elixir on which mankind grows toward a deeper understanding of his nature and purpose – a mountain to mountain climbers.

Many of us, on returning home from space, brought back the perspective of a lonely and beautiful planet crying out for a more responsible attitude from its most prolific partner. Strangely, we didn't talk about the stars much. Perhaps with O'Neill's "seed pods" now emerging the perspective is enlarged again. Not that we should care less for the earth, for it will remain the principal home for most of us for a long time. But now, mother earth need no longer remain barren and generations of diverse offspring can continue to ask why.

LEWIS MUMFORD

Cultural historian, author of **Technics and Civilization; The Story of Utopias; The Pentagon of Power;** *etc.*

Dear Stoart Brand:

If you were familiar with my analysis in the 'Pentagon of Power' you would know that I regard Space Colonies as another pathological manifestation of the culture that has spent all its resources on expanding the nuclear means for exterminating the human race. Such proposals are only technological disguises for infantile fantasies.

Lewis Mumford

LYNN MARGULIS

Microbiologist, author of* Origin of Eukaryotic Cells, *co-deviser of the Gaia Hypothesis

Sorry to be so late to respond to your invitation, but of course things on the surface of the earth, things here and now, always take precedence. That, alas, may also be the fate of the planning for Space Colonies that you ask me to comment on.

The effect of colonialization on the Mother Country self image is immense and incalculable. King George III was accused of "enslaving" his embittered Virginia and Carolina colonists 200 years ago. (It perhaps would have been more accurate to have called the gentlemen colonists slave masters.) However the analogy helped feed the flames and led to irreconciliation with the colonies. Can the effect of the American ex-colonies on the British self-image be assessed?

The Great Britain 4 p.m. tea service, white gloves and all are seen in perspective when Jeremy Button of Tierra del Fuego tried to retain it in the rugged offshore rocky islands of his forefathers. What seemed desperately important in 19th century drawing rooms looked ridiculous in Tierra del Fuego, the Gold Coast and the logging northwest of Canada. The values of the Mother Country must take on a new perspective from the distance of the colony. How small, idiosyncratic, isolating, anti-rational, parochial and repressive seem all tribal and national and imperial customs seen from a distance. I can't think of any exceptions (the American housewife lamenting Nicaraguan attitudes towards time as she waits for the hairdresser in Managua).

Of course Space Colonies are worthy of investigation and investment, in my opinion. (Why do some sun-requiring algae actually live inside carbonate rocks? Why do you find small blind arthopods scurrying at the backs of caves? Why do giant luminescent female fish (carrying their tiny males parasitically) inhabit the abyss? Why do red and green microorganisms cover the newly fallen arctic snows and multiply on its surface? Why do certain funny poorly known fungi (examples in the group Laboulgeniomycetes) live only on the left anterior appendage (read left front toe) of its insect host? The answer is the same as the one to the question why do people like O'Neill and his students imagine Space Colonies and advocate the move out. There are two parts to the answer: (1) the environment exists; and (2) the populations of organisms in question have the capacity to adapt to the environments. No fancy explanations are required. If there is space and if organisms can internally regulate utilizing the sources of energy at hand well enough to insure their replication, organisms will fill the space. This is the evolutionary pattern. It began over 300 million years ago, it still goes on. Steadily more and rougher parts of the earth's surface and near-surface have been colonized. There is no reason to believe the pattern will not continue to go on, at least in the near future.

What is obvious (and you already have said so) is that the John Todds of the World (e.g., holistic biological thinkers and doers) must connect with O'Neill and his crew to help stop the handwaving. Many details are not easily worked out simply because it is said that they are easy. Delivery of all needs, removal of all wastes, transport of the right things to the organisms in the right quantities with the right timing. Easy to say but perhaps incredibly complex to realize. I am not qualified to comment on the engineering difficulties except to perceive that they must exist. Furthermore, I think the working out of the details might be frightfully boring. But then I don't find Space War very interesting either, but (as I know from reading Brand) these issues are a matter of taste and indeed the working out of details might excite lots of differently temperamented people with inventive and exploratory natures. People who liked soldiering and rampages not because they are cruel but because they love excitement, for example, might go in a big way for Space Colonies. (Certainly such types have been highly successful in recent human history – evolutionarily speaking.)

Then there are the priorities. If we invest in Space Colonies from what other budget lines do we take the funds? I wouldn't mind a wholesale transfer from most of medical research to exploratory research on space colonies. Much of our illness is in the spirit anyway, and I like to see people permitted to be sick and die in peace. Although attainment of agreement on budget priorities will hardly be easy, perhaps it can be done.

What we need is a sober assessment of the technical feasibility by those qualified to make it, a nearly intrinsically impossible feat. But it is good to see CQ in the forefront of the search, as usual.

RICHARD RAYMOND

President, Portola Institute (which parented the* Whole Earth Catalog*)

If twelve people become passionately committed to a mission, the mission will succeed. That is an axiom. My friend Virginia Baker says two are enough, and I am inclined to believe whatever Virginia says on this subject, having observed the continuing growth of the Zen community with which she is affiliated. The New Planet mission appears already to have acquired a number of passionate sponsors, and I concluded several months ago that the question is no longer "if" but "how soon."

Another friend whose opinions I trust is Don Michaels, who recently wrote **On Learning to Plan and Planning to Learn**, in which he convincingly argues that the underlying justification of an organized society is to encourage and nurture the ongoing learning of its citizens. Thus an enduring society is not one that sees itself as primarily an aggragation of economic institutions – its economic stability will be a derivative outcome of its capacity to learn and learn and learn, endlessly.

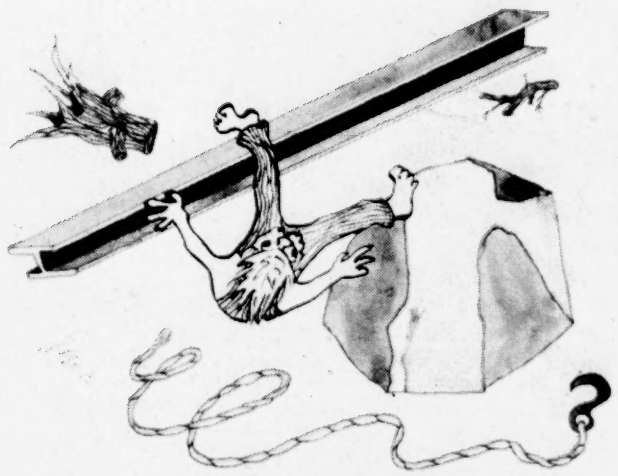
There is no question but that the New Planet is a leading challenge to many of the world's most elite scientific and philosophical thinkers. Unless our culture produces some other more engaging intellectual challenge for this exploring contingent, their project beautifully fulfills the purpose of a human society. And that is not to say the world has no other deeply significant problems to solve; it is equally appropriate that a society encourage its citizens to become involved in each important issue that generates greater understanding. (Here at the Portola Institute, this is called "learning how the world works.")

I, personally, am challenged by some of the mysteries of this planet and am not arguing in defense of the morality, the economic benefits, or the political consequences of the New Planet. Yet I acknowledge it already exists as a project, it expands the understanding of society's members, and I wish godspeed to those who dig it.

The real backers

. . . SB writes "the voters will be interested enough to approve the requisite $100 billion." Since when do voters, or congress for that matter, appropriate money for those kind of projects? They are pushed through by the folks that profit from huge government expenditures (enterprising capitalists and corporations) and passed by the people (government officials) who profit from the profit. Who stimulated European settlement of the Americas? The British East India Company, The Dutch East India Company, the gold seeking Spanish royalty. So realistically, the space colonies will get started when the Exxons of the future decide to monopolize this energy resource too. Solar energy at less than competitive prices? I wouldn't count on it. . . .

Jan Bronstein
Newton, Massachusetts



THE SCULPTOR IN FREE SPACE

DEAN FLEMING

Artist, co-founder of Libre Commune

Space colonies are potentially the greatest creative focus in human history. If we may assume the highest achievement for humankind is to become totally, fruitfully human; responsible for being conscious of every detail of the living environment, heart and mind used for the mundane manipulation of matter while soul abides receiving continuously from the More then clearly the way now to reach such states is to take on the task of a totally integrated colony in Free Space. Every being so fortunate as to be able to participate will immediately be called upon to come up spiritually and psychically to handle the overload of unbridled forces (which may be ecstatic according to some astronauts) and still live the simple human life watching the vibes

WENDELL BERRY

Poet, novelist, essayist, farmer, teacher, author of **The Long-Legged House, The Memory of Old Jack; A Continuous Harmony; Farming: A Handbook.**

Mr. Gerard O'Neill's space colony project is offered in the Fall 1975 **CoEvolution Quarterly** as the solution to virtually all the problems rising from the limitations of our earthly environment. That it will solve all of these problems is a possibility that, even after reading the twenty-six pages devoted to it, one may legitimately doubt. What cannot be doubted is that the project is an ideal solution to the moral dilemma of all those in this society who cannot face the necessities of meaningful change. It is superbly attuned to the wishes of the corporation executives, bureaucrats, militarists, political operators, and scientific experts who are the chief beneficiaries of the forces that have produced our crisis.

For what is remarkable about Mr. O'Neill's project is not its novelty or its adventurousness, but its conventionality. If it should be implemented, it will be the rebirth of the idea of Progress with all its old lust for unrestrained expansion, its totalitarian concentrations of energy and wealth, its obliviousness to the concerns of character and community, its exclusive reliance on technical and economic criteria, its disinterest in consequence, its contempt for human value, its compulsive salesmanship.

The most striking feature of Mr. O'Neill's testimony is his lack of doubt, what I would take to be his unscientificness. He does not speak to us as the appropriately skeptical or dispassionate student of a possibility, but as its salesman. He sees no good alternative to his plan. He has no reservations. Or, rather, he has <u>one</u> reservation: he thinks that "it's very wrong to assume that something like this is going to promise happiness to all people. . ." – a point that will not greatly discomfort the plutocrats at whom ultimately this pitch is aimed.

As a salesman, Mr. O'Neill faithfully utters every shibbolith of the cult of progress. If we will just have the good sense to spend one hundred billion dollars on a space colony, we will thereby produce more money and more jobs, raise the standard of living, help the under-developed, increase freedom and opportunity, fulfill the deeper needs of the human spirit, etc., etc. If we will surrender our money, our moral independence and our judgment to someone who obviously knows better what is good for us than we do, then we may expect the entire result to be a net gain. Any one who has listened to the arguments of the Army Corps of Engineers, the strip miners, the Defense Department or any club of boosters, will find all this dishearteningly familiar.

The correspondence between the proposed colonization of "the high frontier" of outer space and the opening of the American frontier is irresistible to Mr. O'Neill. I find it at least as suggestive as he does, and a lot more problematical. The American prospect after, say, 1806 inspired the same sense of spatial and mental boundlessness, the same sense of limitlessness of physical resources and of human possibility, the same breathless viewing of conjectural vistas. But it is precisely here that Mr. O'Neill's sense of history fails. For the sake, perhaps, of convenience he sees himself and his American contemporaries as the inheritors of the frontier mentality, but not of the tragedy of that mentality. He does not speak as a Twentieth Century American, faced with the waste and ruin of his inheritance from the frontier. He speaks instead in the manner of a European of the Seventeenth and Eighteenth Centuries, privileged to see American space and wealth as conveniently distant solutions to local problems.

That is to say that, upon examination, Mr. O'Neill's doctrine of "energy without guilt" is only a renewal, in "space-age" terms, of an old chauvinism: in order to make up for deficiencies of materials on earth we will "exploit" (i.e., damage or destroy) the moon and the asteroids. This is in absolute obedience to the moral law of the frontier: humans are destructive in proportion to their supposition of abundance; if they are faced with an infinite abundance, then they will become infinitely destructive. Mr. O'Neill sets it down as a false premise "That any realistic solutions to our problems of food, population, energy and materials must be based on a kind of zero-sum game, in which no resources can be obtained by one nation or group without being taken from another." That is the lesson that the closing of the earthly frontiers puts before us; it calls for an authentic series of changes in the human character and community that, if made, will afford us the spiritual resources to live both within our material means and with each other.

Mr. O'Neill proposes to learn no such lesson and to make no such changes. He proposes to outflank the lesson entirely. What we obviously need – as any old buffalo hunter or strip miner would also tell us – is a "new frontier:" some place, that is, where the mentality of exploitation may proceed without restraint, "correcting" the ruin of one place by the ruin of another.

But it seems to me that, in essence, Mr. O'Neill's false premise is true everywhere in the universe. All we have to do is rephrase it in terms of what we know of our history and of the insights of the ecologists, so that it reads this way: Whatever human beings use they must take from the rest of creation, either temporarily or permanently. So phrased, this allegedly false premise is seen to be a practical truth with profound cultural implications. Instead of the moral escape valve of yet another "new frontier" to be manned by an elite of experts, it proposes certain limits, restraints, and disciplines that apply to all of us. It avoids the corporate and governmental big-dealing that will be bound to accompany the expenditure of a hundred billion dollars. And it avoids the open-ended chauvinism, perfected by the strip miners, that is always willing to advocate the destruction (for money, jobs, and the general amelioration of the human condition) of some <u>other</u> place. It has always been possible to export bad character and disrespect, but that can be understood as a solution only by misunderstanding the problem.

This brings me to the central weakness of Mr. O'Neill's case: its shallow and gullible morality. Space colonization is seen as a solution to problems that are inherently moral, in that they are implicit in our present definitions of character and community. And yet here is a solution to moral problems

of the rock and the pond. Every conceivable act would have to be as the Hopis' dream an act of consciousness and inevitable worship. If being creative without ceasing builds humanness in humans imagine how sprung loose God will feel when relieved of the burden of creating the "skies" and the "waters"!

In May 1970 I attended a NASA symposium on habitability in Venice, CA. During which time I lobbied for an experimental community deliberately living as if in space. (Forget about the Arctic! Maybe on some Caribbean Island!) They thought I was nuts. But now they would have 5 years of solid info at their fingertips. Do you think they could go for it yet? Sign me on! I swear all this time I've been painting for that kind of space!

Dean Fleming

THE PAINTER IN FREE SPACE

that contemplates no moral change and subjects itself to no moral standard. Indeed, the solution is based upon the moral despair of Mr. O'Neill's assertion that "people do not change." The only standards of judgment that have been applied to this project are technical and economic. Much is made of the fact that the planners' studies "continue to survive technical review." But there is no human abomination that has not, or could not have, survived technical review. Strip mining, fire-bombing, electronic snooping, various forms of genocide and political oppression – all have been technically feasible, and usually economically feasible as well.

Stripped of the glamour that we associate with adventures in "space" and of the romantic escapism left over from our frontier experience, Mr. O'Neill's project is clearly not a solution, in any meaningful sense, to any problem. It is only a desperate attempt to revitalize the thug morality of the technological specialist, by which we blandly assume that we must do anything whatever that we can do.

Mr. O'Neill's testimony is littered with the evidence of his moral bewilderment. His concern for the environment leads him directly to a plan to strip mine the moon. He says, "I have a deep suspicion of governments," but he does not hesitate to promote a scheme that would vastly increase the power and influence of government. He apparently sees no chance of political corruption in an expenditure of a hundred billion public dollars. He says that he "would far prefer to see a cooperative multinational program formed" to carry out his project, but only five paragraphs later he speaks of the project as a way to return to the "traditional role [of the U.S.] as a generous donor of wealth to those in need." Nowhere does he see the absurdity of trying to solve on a grand scale by expensive technology a problem that can probably be solved on a small scale, and cheaply, by moral means (see E.F. Schumacher's article, same issue). Nowhere does he see the absurdity of trying to solve with existing technology a problem that, as Schumacher suggests, "has been produced by the existing technology."

Mr. O'Neill predicts readily that his scheme will promote diversity and freedom. But he neglects to consider that the machine is already a renegade concept that sees people as spare parts, and uses them as such. Exactly how, one wonders, is this to be corrected by building an even bigger machine and causing people to live inside it, in absolute dependence on it? What, exactly, would be the effect of a completely controlled environment on human character and community? What, exactly, would be the influence of space colonization on earthly political and social forms? Mr. O'Neill does not know, and he has no way to know. He is not, then, merely asking for a public subsidy in the amount of a hundred billion dollars. He is proposing that he and his colleagues should be permitted to experiment with fundamental values. This is the violence of the specialist. This kind of thing is familiar enough. What is new here is the scale.

Perhaps most important of all is Mr. O'Neill's failure to see that the so-called energy crisis is a moral crisis. He assumes that it is simply a matter of scarcity, which can be remedied by the time-honored method of getting more from somewhere else. But it has been obvious for some time that the energy crisis has at least as much to do with the uses of energy as with its availability. The world will tolerate the use of even less energy than it can supply. The question is not of how much energy we can get, but of how much we can use without destroying, at a minimum, our ability to enjoy the use of it. The question of restraint is much more pertinent to the problem than the question of supply. And Mr. O'Neill has apparently never thought to ask what good might be accomplished by the proliferation in space of a mentality that cannot forbear to do anything at all that is possible.

Mr. O'Neill has failed to think of these things because temperamentally he is a scientific super-star. His ambition can comprehend only the grandiose. He is a professional mind-boggler. With the apparent simple-mindedness of the true-believer, he sees himself as the evangelist of the next "giant leap for mankind." He makes the overwhelming presumption of the evangelist – that he knows better than we do what is good for us. And he is asking for an influence over the material means of our lives which will require our spiritual capitulation. Like an evangelist, he wants both our faith and our money.

Finally, I would like to raise the question of what may be meant by this advocacy of space colonization by **The Co-Evolution Quarterly**.

Evolution, as I understand it, is a slow process. It develops gradually, by seasons, like a plant. It paces itself according to the capacities of organisms and the changes of the environment. It involves a profound mutuality of response between an organism and its environment. It is deliberate, meticulously attentive to details. It does not proceed by coup or decree; it does not often risk the wholeness or coherence of its systems. It would not allow one man or any few men to take "a giant step for mankind."

Coevolution I understood to mean a concept of human change modeled on evolution: changing together slowly, coherently, feeling for the right ways with some mutuality of consciousness and regard. Fundamental to it, I thought, would be a suspicion of change by technological or governmental coup. I thought that it grew out of the new awareness of material and moral limits that Mr. O'Neill's project is designed to repudiate.

I admit that I am bewildered. Perhaps I will have to admit that I have been wrong. It is certain, however, that the Fall 1975 issue displays a potentially ruinous split between what I at least have thought to be coevolution and what I think the energy lobby would unhesitatingly recognize as Progress – between the mind of Gerard O'Neill and the mind of E.F. Schumacher. On the one hand we have an admirer of Mr. O'Neill's project saying that if it should be implemented, "maybe humankind could walk gently in the Universe." And on the other hand we have an article by a twenty-year-old scientist at work on Mr. O'Neill's project, in which it is proposed that we should send out to the asteroid belt "a work crew equipped with about one thousand 100 megaton hydrogen bombs. . . ." The editor's implicit approval of both statements makes of the first a vacuous sentimentality. The other, in any context, would be monstrous. □

WILSON CLARK

Author of Energy for Survival

Perhaps the greatest significance of O'Neill's proposal is that it is being taken quite seriously, particularly by the technologically-oriented members of our society. The idea has been rooted in science fiction since the industrial revolution's adolescence, and it has a certain charm, in light of the fact that the very scientific "advance" which we have produced has rendered our remaining earth environment a battleground, pocked with the evidence of technology's increasing sophistication in war, environmental destruction, etc.

I am reminded of the wisdom of Oliver Wendell Holmes, who commented in 1872 that, "Science is a first-rate piece of furniture for a man's upper chamber, if he has common sense on the ground floor."

Notwithstanding the palpable evidence that our science lacks common sense, it is conceivable that we could ignore the implications of this, and build the space colonies – to prove that we could do it. Why? O'Neill's primary rationales are (1) Future energy needs to be met by space-generated solar energy for terrestrial and space use; and (2) Exploitation of lunar materials. From an energy and materials standpoint, the production of metals from space ores would have to exceed the demands on terrestrial energy and materials to construct and maintain the space colony/industry. Given the extraordinary demands on earth materials and energy supplies to initiate the project, it is doubtful that it could meet even this basic criterion.

From an énergy standpoint, there is no compelling need to demonstrate solar energy in space. Solar radiation reaching the earth's surface is ample in most areas of human habitation to provide essential energy needs, at far less cost than a space system.

One practical rationale, which also meets the requirement of common sense, is to proceed with construction of the colony, thereby occupying the time of thousands of technologists and planners, who otherwise would be spending it inventing new genetic manipulation techniques, plutonium warheads, nerve gases, etc. If the colony were actually built, they could be sent there *en masse*, relieving earth of an annoying burden.

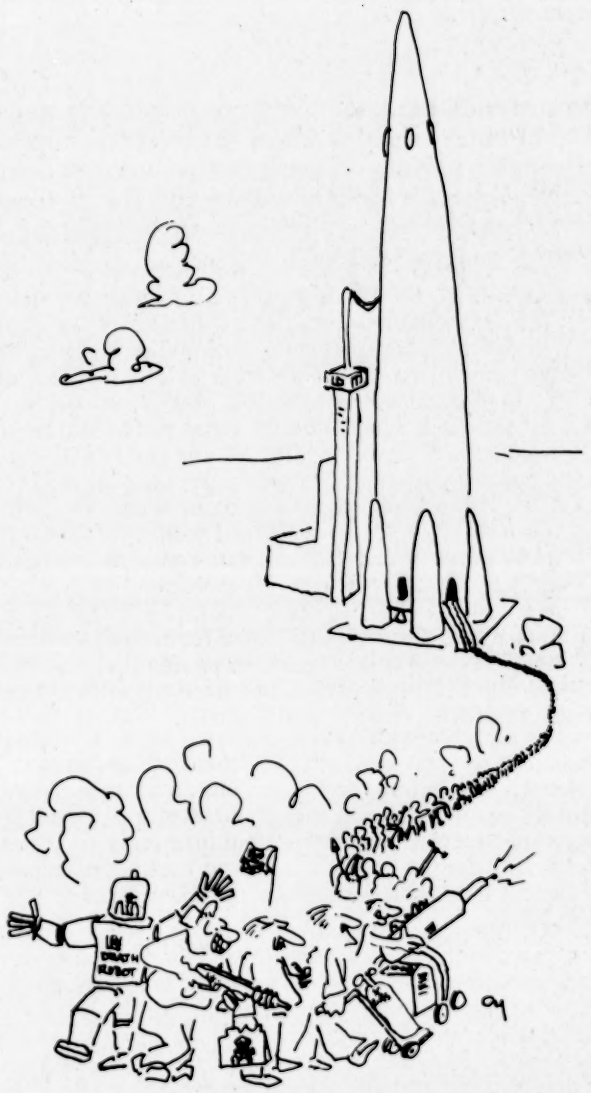
In proposing this idea, O'Neill has done us all a favor, by forcing us to ponder our philosophies and approaches to life on (or off) this planet. What if we were now living in a space colony, debating the possibility of colonizing earth? Would we be asking the same questions? I think not. From the viewpoint of a creature in some metal and plastic isolated environment, the key question would probably be seeking the companionship and cooperation of the diverse population found on earth, rather than avoiding it for the "safety," or "high technology" of a space cocoon.

Stewart Brand's incisive remark in the Winter CQ, that self-sufficiency has done more harm than good, reflects a far more important view of the future than space fantasy. By taking stock of our precarious existence on earth, we can begin to rethink our relationship to technology and value, and hopefully find some approaches to help us redress many of the wrongs already accomplished by our species. What we need is nothing less than a quantum leap in our approach to science, relieving ourselves of the onerous image of *Homo absurdus*. O'Neill speaks in terms of a "first beachhead in space," evoking the image of the greener grass on yonder hill. Unfortunately, we have little time in which to prevent the elimination of the vegetation altogether.

Space for peace

. . . O'Neill is as convincing as the Atomic Energy Commission was advocating the benefits of Nuclear Power. . . .

Barry Hughes
Eureka Springs, Arkansas



E. F. SCHUMACHER

Economist, author of Small is Beautiful.

Yes, Stewart, I'm all for it. I am prepared to nominate, free of charge, at least five hundred people for immediate emigration. For every one of these emigrants, once they are well and truly gone, I am prepared to donate $1,000.00 US dollars for the furtherance of the work that really needs to be done, namely, the development of technologies by which ordinary, decent, hardworking, modest and all-too-often-abused people can improve their lot. With the above-mentioned emigrants out of the way, it will be a great deal easier to obtain support for this work.

P.S. "As for those who would take the whole world to tinker with as they see fit, I observe that they never succeed."
– Lao Tzu

STEPHANIE MILLS

Writer, speaker on population and environment

Apropos of space colonies, the sainted Walt Kelly expressed a basic qualm better than ever I could. To wit:

"I feel that we have done little enough with our present world to warrant our going off and putting soft-drink signs all over Mars and cluttering up the moon with oil rigs. These places are not ready yet for such advanced achievements. We should really go a little more slowly. We don't expect kangaroos to whistle 'Dixie,' do we? Not the first try, anyway. Let the universe come here when it's ready. Don't rush it."

Me for tending to home sweet home, that's frontier enough.

STEVE DURKEE

***Artist (cover, this CQ), co-founder of Lama Foundation, book designer of* Be Here Now; Seed; Toward the One**

The positive feelings that I have for such a project rest on the assumption that we will get more out of it, in terms of net energy gain, than we put into it. In order to make such an assessment, I feel that we need to do further research & exploration of leads turned up by Skylab & other missions. Items like: promising fishing grounds indicated by observation of ocean currents, surface & geologic indications of subterranean water sources in West & Saharan Africa, surface hot spots indicating geothermal energy sources, location of ore & oil deposits suggested by aerial photography. If it could be shown that some of these leads pan out it would become much easier to convince the people & those who control the purse-strings that funding of such a project could result in manifest gains. Also I would think that there would need to be future Skylab related missions which would specifically undertake research & development work in Zero-G conditions in the fields of crystalography & metallurgy since it seems that much could come from this in terms of computer based technology perhaps paving the way for a new generation of computers freed from planetary restrictions & hazards.

Going down the line of positive feelings; 1) Planetary Consciousness: Furtherance of whole earth thinking provided by daily input to the planet surface of planetary phenomenae affecting local & global interests. At present we have such feedback (weather, re-con, etc.) but what I envision is more at the level of World Game, International Design Decade, Club of Rome kind of material (weather patterns, tidal flows, crop patterns, inventory & mapping, etc.). People would become used to the whole earth, seeing it they would not see all those funny lines denoting political divisions, arbitrary in many cases, but would rather learn to think in terms of regions rather than nations, biotic provinces rather than NATO or SEATO, geo-oceanographic reality rather than trade embargoes with island republics, watershed reality rather than states rights. When the blood & guts of Viet-Nam began pouring out of the TV News onto the living room floor the peace movement in America began to extrapolate; similarly I feel that the whole ecological awareness of people & their understanding of inter-relatedness would be vastly accelerated by information (visual & sensory) that could be provided by the stations.

2) Energy Transmission Stations: Tho this seems the most promising, cheap, clean power I have yet to understand from reading the articles what the proposed means of transmission would be. So far as gathering the solar energy this is not so different from what we have already been doing with the various probes, missions & skylab experiments. I can also see that crystals necessary for conversion of solar energy into electrical energy could conceivably be produced with a greater rate of success than on the planet (the high cost of such crystals I understand comes from the fact that there is a fail rate of 90%+ in the manufacturing process). But the big question I am left with is HOW it gets from there to here? Do you convert solar energy to radio waves, beam to earth, radio waves convert to electrical energy? Seems like a lot of steps & how much is lost in each step? Further I can't quite see in economic terms why, when we are told that it is not feasible here on earth, to use large areas of Aztlan (Sonoran Mexico, New Mexico, Arizona, So. Cal., Nevada, etc.), Saharan Africa, The Hedjaz, The Afghani-Iranian Desert, The OutBack of Australia (to mention a few possible places) to produce solar energy, why would it be more feasible to try & do the same in space? But it seems as tho there are possibilities in the area of Transmission so this remains a positive area for me.

3) Cosmic Ship or Ark: I dont feel it's necessary to elaborate on this. **Cities in Flight** by J. Blish as well as countless sci-fi novels plot this scenario. For one reason or another, a station decides to go off the line & the rest of it I leave up to your imagination. Pirate Stations & Rogue Stations, Interplanetary & Intergalactic(?) Travels. Generations growing up in space with only rare visits earth side; that should breed a whole new type of being. This is probably my favorite plus reason.

My negative feeling about such a project revolves around the kind of "Pie in the Sky" vibration which I feel from the project. Given the problems we are facing from population overload & its attendent horrors: famine, land rape, water pollution, dwindling resources, etc., etc., I wonder as to the wisdom of putting before people the idea or even the possibility of "getting out of here," when here is where the work is, here is where the problem is. At that level it seems like escapism, and as such the last place where we should put our energies.

As for recommendations; I feel that the project should become an international one from the start. That all phases of the project should be based on the ideals of co-operation & co-elaboration both on an international level & inter-disciplinary level. That people chosen to work on such a project would blend together rigorous scientific methods with ecologic awareness & whole systems mentality & hopefully that the mystical & transcendent implication of the project would be deeply considered.

Within this project there is the germ of a possibility in creating something which would serve to focus the aspirations & consciousness of many people the world over. What Sputnik did for the last generation this could do for the next. When I told my nephew what I was typing he said, "I'm ready, when's it happening?"

In short even if economically it was a borderline case there are other payoffs which might seem ephemeral at first but which could provide more important, if subtler, payoffs. This will be in the hands of the inceptors & the kind of values they stress & put forth. If it were handled wisely it could gain somewhat of the aura that the ancient Olympic games had & as such might serve as a model or operating symbol for world & planetary evolution. One could, for instance, move the UN into space. That would change the game.

In closing I would like to offer a cautionary tale;

One sunny spring morning leaning up against the east wall of an old adobe, soaking in the warmth, the fields around beginning to green, the apple trees in fresh bud, the freshly turned earth of the vegetable patch steaming, I was listening to this old man, can't remember if he was a Sioux or Kiowa, talking to a group of us "younger boys." He was talking about the red people & the green people & what he called "the hurry up & let's go" people. He was saying something like; "You know them hurry up & go people. They always want to go someplace else. Never like it where they are. I betchyou them people they just going to hurry up & go out there (pointing heavenwards with his pursed lips). Yeh, that's all right & God bless them, they don't like this one here anyway (patting the earth with his hand). Yeh, they just gonna up & go. But one thing you should tell them, those boys they gotta be careful, real careful with that moon."

That's all Folks, BE CAREFUL WITH THE MOON.

Extra energy

. . . Extra-terrestrial solar energy should remain there. Extra energy, only adds to the positive feedback of the very system which created all of the problems which O'Neill wants to solve. Aside from the damage that all this energy will do when put to work (what will the "limitless" amount of electricity do besides create more of the same?), the thermal effects can only create new, unforseen problems. Claude Summers (**Sci. Amer.** Sept. 1971, "The conversion of energy") has demonstrated that, assuming all pollution problems associated with energy production were totally solved, "waste" heat would inevitably provide overriding negative feedback and bring limits to growth. All energy beamed to earth must end up as heat. Only invariant systems of energy production (systems that add no energy to the earth besides naturally received solar energy) can avoid adding excess, and potentially damaging, heat to the biosphere. . . .

Eric Alden Smith
Ithaca, New York

STEVE BAER

Inventor, writer, president of Zomeworks, author of **Dome Cookbook; Zome Primer; Sunspots.**

I can't keep my own car running, can't fix a broken radio or light bulb – who am I to recommend anything as complicated as a space colony?

The project is spoken of as if it were direct as our stepping over and grabbing a large rope, giving it a huge pull and flinging people into space. But I know that instead it consists of orderforms, typewriters, carpets, offices, and bookeepers; a frontier for PhD's, technicians and other obedient personnel.

Once on board, in my mind's eye I don't see the landscape of Carmel by the Sea as Gerard O'Neill suggests. (He must keep his eyes on his shoes and not breathe too deeply in order to suggest duplicating the pacific coast aboard the space colony.) Instead, I see acres of airconditioned Greyhound bus interior, glinting, slightly greasy railings, old rivet heads needing paint – I don't hear the surf at Carmel and smell the ocean – I hear piped music and smell chewing gum. I anticipate a continuous vague low-key "airplane fear."

There is something especially boring about car nuts talking endlessly about different model cars. I am suspicious that the space stations are the next step for these people, for the whole world would have a manufacturer, a model number, etc. Who would ever be able to shut them up once one got started on the "AJAX 8" or O'Neill's "Island One"? Absorbing yourself in all that is to me just barely second best to putting in your time looking at your own asshole with a mirror and a magnifying glass.

I admit, though, that there is something fascinating about the Space Colonies. They might be the perfect cure for the "car nuts" – probably after a term in such a place you'd never want to see another piece of machinery again – just go off and roll in the dust for a year.

Of course the positive side is that Space Colony activity is less dangerous than multiple war head guided missile activity – but I'm sure others will describe such advantages. Space Colonies = Methadone for technology junkies?

How would the skylights be kept clean? One envisions thousands of scrubwomen, their role in society still preserved intact. – *Larry Todd*

The SF vote

. . . What a project.

I'm hooked.

My 17-year-old brother who's also quite a fan of your magazine (and very much into the Whole Earth mentality) was super-cynical, predicting that it wouldn't work technically, that the ecology would fall apart in "a big bottle," and that the government would be a totalitarian autocracy, with absolutely no personal freedom allowed. My question: why did we react so differently? Was it, perhaps, because at his age I was reading 5 - 10 science fiction books a week, while, to the best of my knowledge, he's never read one? (I myself haven't read more than 2 - 3 in the past four years, something that will no doubt change now that dreaming isn't so painful anymore.). . . .

Jose Garcia
Naperville, Illinois

DENNIS MEADOWS

Social technical-systems analyst, co-author of **The Limits to Growth; Dynamics of Growth in a Finite World.** *This one was a conversation.*

"I have a mixed mind about L-5.

"My impression is that there are cheaper ways, ways less demanding of capital, to satisfy any goal put forward by the L-5 effort – to do that on Earth rather than to do it in Space. You cannot justify the L-5 effort in any sort of physical terms.

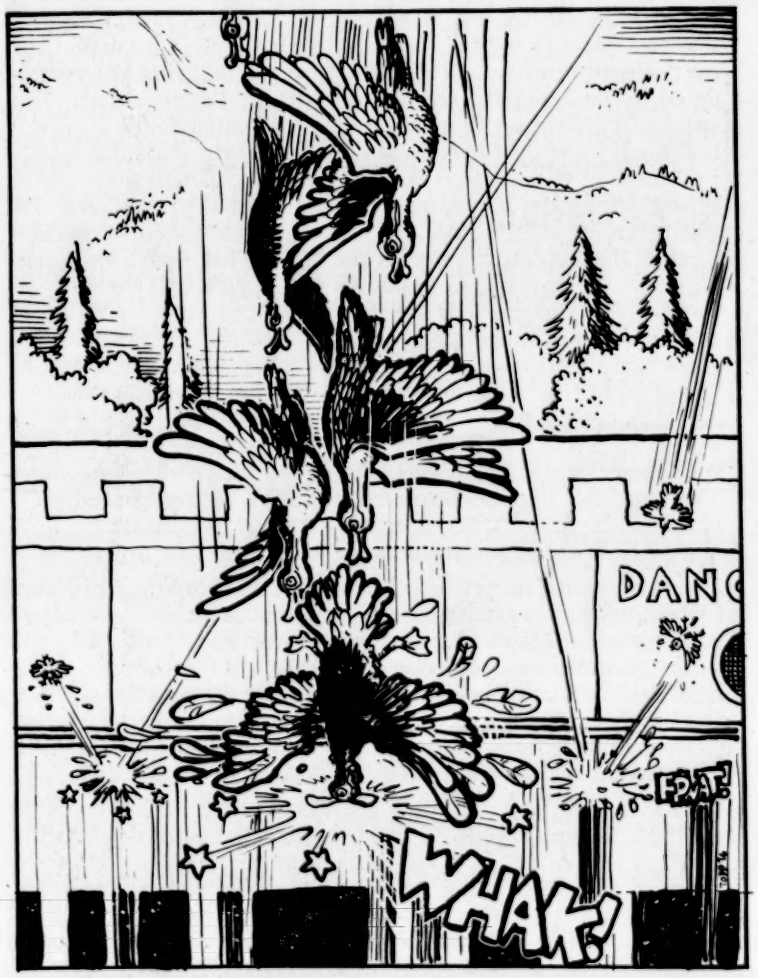
"It plays a function, which may be negative or positive, of giving us another frontier, when we've used up all the ones we have on Earth. I'm not sure if we should want to have another frontier. It seems to me to block constructive response to problems here on Earth. If you look around at societies to find those that have come into some sort of a peaceful harmonious accommodation with themselves, many of them turn out to be on islands, where the myth of a new frontier vanished long ago."

SB: How did they get to the islands in the first place?

Meadows: Well they migrated. I'm not sure that we want a new frontier. If we do, this is a nice way to do it.

"But now let's turn to things like providing food or energy here on Earth. Of all the ways I can think of doing that, L-5 is very costly, risky, and long-term. The thing that it doesn't involve is institutional and value change. Our current values and institutions will give us an L-5, conceivably.

"What are needed to solve these problems on Earth is different values and institutions – a better attitude towards equity, a loss of the growth ethic, and so forth. I would rather work at the root of the problem here."



Living in a big rotating cylinder in the absence of true gravity might play havoc with the instincts of migrating birds. –*Larry Todd*

STANLEY MARSH III

TV station owner, art patron

When you wrote me concerning my participation in your magazine's discussion of sending intelligent life to live in outer space, for some reason I remember, perhaps scatologically, urinating in the same toilet bowl with my father when I was three and he was 28 and looking up at his kind face, (he looked like a nice George Raft) and then down into the toilet bowl where the stream of intelligence I was sending was for all intents and purposes, in my mind, killing Japs.

When I was being toilet trained, Lucky Strike Green was going to war. The Jap submarines were sinking our boys over there at alarming rates and blimps sailing over the Pacific would depth bomb and machine gun the Jap submarines to death. I knew, because I heard it on the radio, and I was terrified of it. My father, this kind, young George Raft, was smoking Lucky Strikes only in the bathroom of my grandmother's house because my grandmother once again was quitting smoking because it was unladylike, so the toilet bowl was always filled with cigarette butts. I would wait until my father left the bathroom where he had been smoking and I would rush into the bathroom to sink all the cigarette butts with stream-of-urine bombs and bullets, pretending the butts were Jap submarines, chasing them about in the toilet bowl until I would sink them against the shore, and all the tiny little Japs (who looked like tobacco anyway) would sink. I loved to make direct hits and see them explode in mid-water and each time I sank one, it was for Our Boys who had died under the water at Pearl Harbor. So now maybe that's why when I think of capsules with living people in them being sent out into an airless environment, I think of elimination of waste and enemy agents, though, of course, I am a rational adult and tobacco now reminds me of cancer, the wickedness of the western world and starving babies in Bangladesh. At any rate I have grown taller and further from the action and have found that filter tips don't explode like Jap submarines, but they do pollute, and the use of the water in the toilet bowl is ecologically serious in the childhood game of being toilet trained. The amount of water flushed every day gives me the feeling we are using our globe for fossil fuel and that it is being done today on a magnificently overwhelming wicked scale by companies called multi-nationals.

So I guess that's the background on my thoughts concerning the exploration of outer space.

I think that outer space will be explored, occupied and used first by multi-national companies like ITT whose president, Harold Ganeen, will have the money and technology to effectively mass together the limited resources (which he is currently using up at an alarming pace) to create colonies of executives of multi-national concerns so they can avoid warrants for their arrest, which will be put out as soon as the U.N. becomes strong enough to issue warrants for global criminals. In my mind multi-national executives steal from more than one company at once, and like Robert Vesco, flee to other countries to avoid justice. When some global occurrence, such as atomic war in Africa over copper mines, causes the government to issue summonses and put these executives in prison, who are learning that stock is more important than money and are simply buying their way to freedom by escaping the limitations of the planet, I say this is good. They will be our first pilgrims, these global criminals, which we will eliminate from this world as waste, and these first colonists will have the same problems the other first colonists had except instead of calling their problems Indians and planting corn, their problems will be skin cancer and how to use human waste and Jupiter astroids to plant their so-called corn (probably algae) and I imagine it certainly won't taste that good.

These colonists, these corporate criminals who will inhabit these floating-in-space colonies, will be intelligent men with ample resources to solve the problems at hand. Should they die, we won't regret their death. The serious and strong minded among us should be not the Japs and be placed in the position of the cigarette butt submarines that I used to sink when I was closer to the action. The people who decided to blast off into outer space to escape their crimes will be the new enemies. Those few of them who leave us for outer space will have to look back on this globe and see the scope of their crimes – smog, starving babies in Bangladesh, strip mines – on an aging, balding planet.

You want to know what it's like to take off in a rocket? Go to the top of a tall building 30 stories high (the same height as a rocket) and as the sun slowly goes down, and the lights of the city slowly come on, it is like a rocket taking off in slow motion, until finally it is totally dark and you can imagine that there you are in a rocket with no horizon line, only a geometric pattern beneath you.

I'm happy for these future pioneers of outer space, Stewart. I always cry in "Willie Wonka and the Chocolate Factory," when Charlie wins and takes off on a wonkawagon which goes every which way to survey his kingdom to see what nice things he has done. But Harold Ganeen's view of the "nice things he has done" will be the oil spills spreading pollution around the world and the fat cats with their computerized wealth pyramiding their problems on the poor, and the strip mines which I am afraid are becoming so vast that when space travelers come to visit us, they will see them before they see our beautiful grid of freeways.

Yours for a penal code in outer space – the Australian way to colonize.

Sufficient error

. . . Space Colonies becomes a good idea only when error-correction becomes impossible here.

Are we there yet?

I don't know.

That's error enough. . . .

M. Phillips
Kokomo, Indiana

PAUL and ANNE EHRLICH

Population biologists, environmentalists, author (Paul) of The Population Bomb; *co-authors of* Population, Resources and Environment; The End of Affluence. *Paul co-conceived with botanist Peter Raven the concept of co-evolution, our founding idea.*

The prospect of colonizing space presented by Gerard O'Neill and his associates has had wide appeal especially to young people who see it opening a new horizon for humanity. The possible advantages of the venture are many and not to be taken lightly. In theory many of humanity's most environmentally destructive activities could be removed from the ecosphere entirely. The population density of the Earth could be reduced, and a high quality of life could be provided to all *Homo sapiens*. It might even make war obsolete.

What can one say on the negative side about this seeming panacea? At the moment the physical technology exists largely on paper, and cost estimates depend in part on numbers from the National Aeronautics and Space Administration (NASA) – not necessarily a dependable source. There appear to us, however, to be fewer barriers inherent in the further development of the O'Neill technology than in others in which society has committed itself to large, open-ended and highly speculative investments – fusion power technology being a prime current example, the atomic bomb one from the relatively recent past.

On the biological side things are not so rosy. The question of atmospheric composition may prove more vexing than O'Neill imagines, and the problems of maintaining complex artificial ecosystems within the capsule are far from solved. The micro-organisms necessary for the nitrogen-cycle and the diverse organisms involved in decay food chains would have to be established, as would a variety of other micro-organisms necessary to the flourishing of some plants. "Unwanted" micro-organisms would inevitably be included with – or would evolve from – "desirable" ones purposely introduced. Furthermore in many cases the appropriate "desirable" organisms for introduction are not even known to us. Whatever type of system were introduced there would almost certainly be serious problems with its stability – even if every effort were made to include many co-evolved elements. We simply have no idea how to create a large stable artificial ecosystem. For a long time it's likely that the aesthetic senses of space colonists would have to be satisfied by artificial plants, perhaps supplemented with "specimen" trees and flower beds.

The problems in the agricultural modules would be less complicated but very far from trivial. Since, according to O'Neill, agricultural surface is relatively cheaply constructed, it seems likely that early stations should have perhaps four times as much as required to sustain the Colony, and that it should be rather highly compartmented and diverse to minimize the chances of a disaster propagating. A great deal of research will have to go into developing appropriate stable agricultural systems for space. The challenge is fascinating – especially because of the variety of climatic regimes possible, the potential for excluding many pests, and the availability of abundant energy.

We can say, then, that although there appear to be no absolute physical barriers to the implementation of the O'Neill program, potentially serious biological barriers remain to be investigated. What about psychological, social, and political barriers? The question of whether *Homo sapiens* can adapt to the proposed space station environment seems virtually answered. Six thousand men live for long periods on a Navy super-carrier orders of magnitude smaller than a proposed space habitat, without women and without the numerous other amenities envisioned by O'Neill. Many city dwellers pass their lives in a similarly circumscribed area and in much less interesting surroundings (travel among stations and, occasionally, back to Earth is envisioned). There is little reason to doubt that most people would adapt to the strange situation of access to different levels of gravity.

Whether or not society will support the venture is another matter. Much may depend on whether O'Neill's calculations on the profitability of the solar power generating enterprise stand up under closer scrutiny and limited experiment. The strongest objection that will be raised against space colonization is that it cannot help humanity with the problems of the next crucial decades, that it will divert attention, funds, and expertise from needed projects on Earth, and that it is basically just one more "technological circus" like nuclear power or the SST. That Space Colonies will have no immediate impact is recognized by O'Neill, but he would argue that we should look to medium range as well as short range solutions. Diversion of funds and expertise also do not seem extremely serious objections. There is, for instance, no sign that capital diverted from, say, a boondoggle like the B-1 bomber, will necessarily be put to "good" use. Equally it does not follow that money for space colonies must be diverted from desirable programs. The expertise needed is superabundant – many trained aerospace engineers, for example, are not able to find appropriate employment now.

The problem of diverting attention from immediate problems like population control is much more serious and can only be avoided by assiduous care on the part of O'Neill and other promoters of the project. Some of O'Neill's associates have done his cause great harm by not realizing this. At every stage people must be reminded that for the potential of space colonization to ever be explored, society must be maintained for the next three decades.

Environmentalists, including us, had a strong negative reaction to the O'Neill proposals when first presented with them. They smack of a vision of human beings continually striving to solve problems with more and bigger technology, turning always away from learning to live in harmony with nature and each other and forever dodging the question of "What is a human being for?" But again O'Neill's vision shares many elements with that of most environmentalists: a high quality environment for all peoples, a relatively depopulated Earth in which a vast diversity of other organisms thrive in a non-polluted environment with much wilderness, a wide range of options for individuals, and perhaps time to consider those philosophical questions. The price of this would, of course, be a decision that a substantial portion of humanity would no longer dwell on Earth.

Environmentalists often accuse politicians of taking too short-term a view of the human predicament. By prematurely rejecting the idea of Space Colonies they would be making the same mistake.

Pioneer

. . . I'm fourteen years old right now, and I think in, say, 20 years, this planet is going to be pretty cramped. Not only for humans, but for other living beings too. Resources of every kind will probably be shot for the most part.

It's a good idea to have an alternative ready.

The people who are saying "no, no" now, will be screaming "yes, yes" then – a little too late. . . .

I'd like to go – do my teensy bit for depopulating the Earth. The idea of going scares me, but I think I could overcome that. Yes . . . I'd definitely like to go.

Paula Read
Inverness, California

Down the road

A journey of a thousand miles does not end with the first step.

My mind is not Earth-bound,
My body doesn't want to be either.

Charles D. Walker
Bedford, Indiana

ERNEST CALLENBACH

***Author of* Ecotopia *and* Living Poor With Style**

Of course it is a beautiful mad vision, and the best part is how you would be able to fly under your own power from the "high" part of a space colony!

But it is only possible to arrive at even quasi-rational social decisions about such proposals if we have something to compare them with – in this case, what we could do with ca. $100 billion if we spent it on a similarly devoted effort here on Earth. How much R&D on Earth-surface solar energy, thermal-gradient sea energy, wind energy, etc. could we buy for that kind of money? I suspect an enormous amount – and it could encourage decentralization, democratization, preservation of biosphere, etc., wheras I shudder to contemplate hundreds (thousands?) of 5000 MW microwave beams coming in to the US alone from space colonies, frying anything that got in their paths!

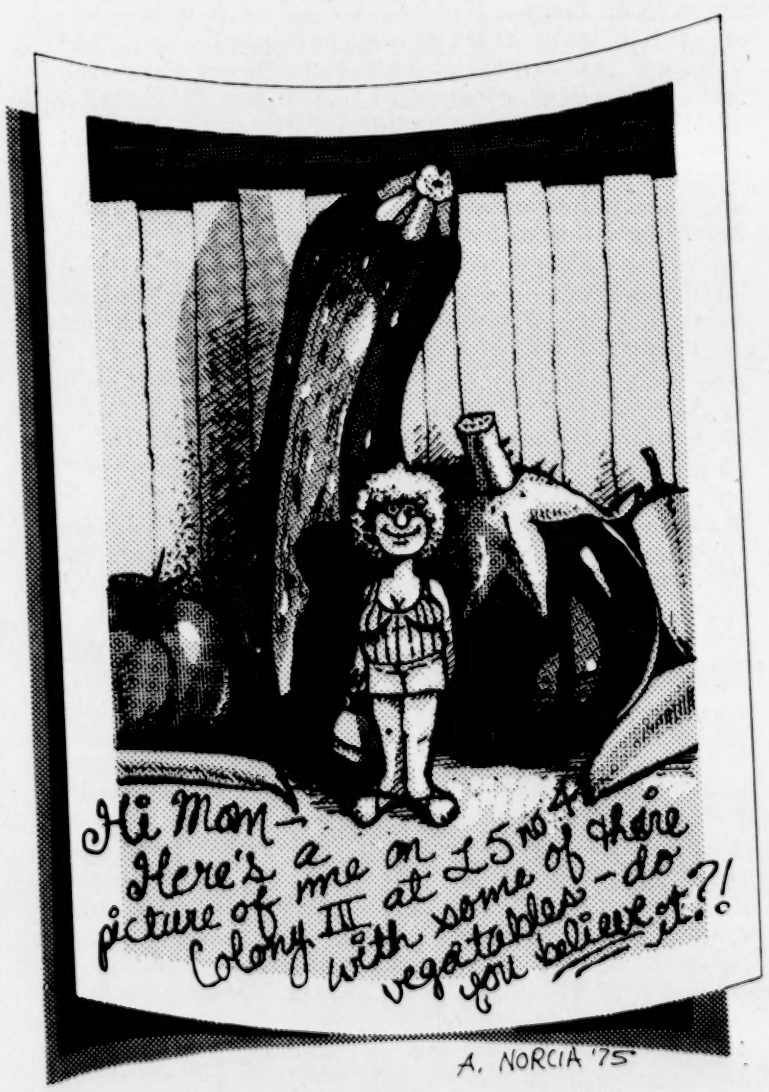
Thus, if you and O'Neill and friends wish us to think seriously about the question, these alternatives must also be explored, and in equal depth.

Of course the decision may not be highly susceptible of a rational solution, for (as with Apollo) the practical pay-offs of a successful space colony might not be nearly as important as the symbolic pay-offs. I suppose what you meant by the Law of Paradoxical Effects is that if an intelligent species which cannot even feed itself decently on the good green Earth still contrives to live in the inhospitable environment of space, the example would be so stunning that all would understand the necessity of establishing steady-state, closed-cycle, biologically self-sustaining communities here on Earth. In short, by doing it at stupendous expense out in space, we would see what needs to be done in the easier yet also grubbier and less inspiring conditions here on Earth.

But there are other ways of approaching that goal too. And the bigger the space colonies were to be, the more these alternatives might appeal. We might, for example, devote a couple of billion to building several of Soleri's "arcologies," thus avoiding such problems as the possibility of someone punching a hole in the space-colony skin and killing everybody aboard – a kind of worry which would almost surely lead to unpleasantly authoritarian social systems in the colonies; whereas here on Earth, bad as things are, we have a certain survival leeway and thus the capacity to tolerate risks. I am not greatly impressed by the social atmosphere implied in the arcology structures either, incidentally; to me it seems that only low-energy, decentralized, moderate-technology societies can give us what we need in the way of more democracy, more room for individual creative enterprise, more happy and loose living.

Which brings us to the consideration that most of the still rapidly increasing people on Earth do not really most need at present (and will not need for some decades) the benefits of energy beamed from space. They need low and intermediate technology of kinds that do more ecological good than harm. We of the advanced, privileged countries may concern ourselves with what we fancy as the next step of evolution, but unless we provide for those present needs we are not going to get any thanks for it from most of Earth's population. That doesn't mean we can only hand out better hoes (handing out examples of biologically sound, self-contained survival communities would be worth a lot too) but it certainly doesn't allow for fantasies of celestial-suburb industrial parks either.

I also wonder, incidentally, if the drive toward living in space has a subterranean atavistic element. The astronauts kept telling Tom Wolfe about their search for the transfiguring Real Stuff; they weren't too clear about what exactly it is. But God, as we have all been told, lives up there beyond the clouds somewhere. Could it be, therefore, that people who want to live in space have the unconscious feeling that it might put them closer to Him?



CARL SAGAN

***Space scientist, exobiologist, author of* Intelligent Life in the Universe, The Cosmic Connection**

I think "Space Colonies" conveys an unpleasant sense of colonialism which is not, I think, the spirit behind the idea. I prefer "Space Cities."

One of the many virtues of the Space City proposal is that it may provide the first convincing argument for extensive manned spaceflight. The earth is almost fully explored and culturally homogenized. There are few places to which the discontent cutting edge of mankind can emigrate. There is no equivalent of the America of the 19th and early 20th centuries. But space cities provide a kind of America in the skies, an opportunity for affinity groups to develop alternative cultural, social, political, economic and technological life-styles. Almost all the societies on the earth today have not the foggiest notion of how best to deal with our complex and unknown future. Space cities may provide the social mutations that will permit the next evolutionary advance in human society. But this goal requires an early commitment to the encouragement of cultural diversity. Such a commitment might be a very fitting Bicentennial re-dedication to what is unique about the United States.

Rather

. . . I would rather have gone with Hank Hudson, Sam Champlain, or Lewis & Clark, but . . . now is yet. . . .

Timothy C. Cornwall
New York, New York

WILLIAM IRWIN THOMPSON

Author of At the Edge of History; Passages About Earth; *co-founder of Lindisfarne*

We need to transform our civilization, not simply extend it. If we extend ourselves as we are now, we will simply be setting up metastases of the carcinoma of industrial civilization. If we are going to move out into space, we will have to learn how to be inhabitants of the universe, and that will require a transformation of consciousness. Such a transformation of consciousness was beautifully expressed by Rusty Schweickart in the piece you published last summer. What I am asking for is an exercise of imagination more profound than the science-fiction fantasies of the comic books of a generation ago. It is not an exercise of imagination to envision solar energy as the means of beaming down intense concentrations of power to drive capital intensive economies of scale. There is abundant solar energy on the earth for a good life. It may not provide enough energy to fly Ritz Crackers in jumbo jets to Venezuela, and if it doesn't we need to rethink the whole kind of crazy economy we have created. If that economy is now running out of energy, perhaps there is good reason for it to do so.

I don't see anything wrong with setting up a colony in space but I do see something wrong in thinking that one can create wildness by placing it into a container. At the present time, there is a battle going on in American culture between those who are trying to surround management with Culture, and those who are trying to surround and contain culture with Management. If the space colonies are sold to the American public as a way of escaping the juggernaut of apocalypse, of escaping the internal contradictions of our industrial civilization, and of not having to face those contradictions but simply to extend, extend, extend always to a new American frontier, then I think we will overextend ourselves to a point of a deserved collapse. I think the space colonies excite the Faustian imagination of the managers and the technocrats for it offers them a way of continuing their existence without going through the pain of a transformation of consciousness. Though I see nothing wrong, in and of itself, with the idea of an experimental small colony in L5, I do see a lot of things wrong with the hype that is being generated in order to sell the American public on colonies, so that they will encourage congress to pass the appropriations. You, yourself, are guilty of encouraging some of this hype by captioning an article on the colonies as apocalypt goodbye to the juggernaut of apocalypse. The apocalypse, in the fashion of the Tibetan book of the dead, is but the malevolent aspect of beneficent dieties. If we can in the face of famine, pollution, and war, remember our Buddha-nature, then we can go through the terrifying initiation of the race to discover that the apocalypse that we seek to escape is inside us, and until we come to terms with it, it will follow us wherever we go – to L5, to the moon, or to Mars. Since all of us have to make some kind of choice as to what work will receive our limited energies, I prefer to work to create a planetary, decentralized, meta-industrial village on the surface of the face of the earth. Earth may not be the best place for a highly technological civilization, but it is, as Robert Frost said, "The best place for love. I don't know where it's likely to go better."

(The rest of it)

I'd like to get away from earth awhile
And then come back to it and begin over.
May no fate willfully misunderstand me
And half grant what I wish and snatch me away
Not to return. Earth's the right place for love:
I don't know where it's likely to go better.

–Robert Frost

Sent by John Graham
Guernewood Park, California

GEORGE WALD

Biologist, pacifist; Nobel Prize 1967

CoEvolution has asked me to write my thoughts about Space Colonies – O'Neill's or any others. Let me say at once that I view them with horror.

I am a little late in getting this to you since I spent the last eight days in Rome as a member of the Bertrand Russell Tribunal II, hearing testimony on U.S. imperialism in Latin America and the atrocities being committed by the atrocious military dictatorships we have set up and maintain there. That too was horrifying; and not altogether irrelevant to the present subject. If we took better care of what goes on here, if we managed to live decent human lives in decent environments, if we relieved the exploitation and oppression of life on Earth, human and animal, and of the Earth itself, living in space might seem less enticing. And we could use the wealth and energy that it would take to put a colony into space to do some of these other things.

What bothers me most about Space Colonies – even as concepts – is their betrayal of what I believe to be the deepest and most meaningful human values. I do not think one can live a full human life without living it among animals and plants. From that viewpoint, urban societies have already lost large parts of their humanity, and their perversion of the countryside makes life there hardly better, sometimes worse.

We are cultivating a race of fractional human beings, living in fractional environments; machines for living for human parts; providing mass produced and standardized unit spaces for depersonalized human units.

The whole concept of space colonization carries this impulse to the ultimate limit. What has already gone much too far on Earth in technologizing all aspects of life – nutrition, motion, medicine, birth and death and everything between – will find its complete consummation in space.

A few years ago I had a strange experience at the University of Vermont. The students had organized a symposium on "Man-made Men." I had taken that title to be ironic, symbolic, hyperbolic. A few days before the symposium, I learned with dismay that it was meant literally. Those students, brought up and surrounded by mass-produced objects, were excited by the conviction that within another decade human beings would be produced in that way. They were looking forward eagerly to coming off an assembly line. When I told them this is absurd, neither possible nor desirable, I had a fight on my hands. Their first response was that I was old and behind the times.

So that my point is that the very idea of Space Colonies carries to a logical – and horrifying – conclusion processes of dehumanization and depersonalization that have already gone much too far on the Earth. In a way, we've gotten ready for Space Platforms by a systematic degradation of human ways of life on the Earth.

A nice example of that is in the major developments of architecture throughout this past generation. It's all gone to designing monstrous machines for human existence in the cheapest ways out of the shoddiest materials.

All around me at Harvard buildings are going up of poured concrete, surely the ugliest and least durable of all construction materials, gray and dead. Pier Luigi Nervi is their prophet. I am told with enthusiasm, "You see, we don't smooth the concrete. We leave the board marks. You can even see the grain of the wood!" That's just great! Wood made out of poured concrete! Like shingles of tar paper or extruded plastics.

Le Corbusier designed a building for art and design students here, the Carpenter Center, of poured concrete of course. Unfortunately, the building itself is the showpiece. It's a goldfish bowl – visitors can see from outside everything going on inside. There is no privacy whatever. Just the thing for an artist.

Walter Gropius, ending his career at Harvard, designed a major living space for students. Again, the shoddiest materials. Every room was a unit space for a unit student, small and forbidding, lined with cinder block. One couldn't drive a nail to hang a picture. In the open space outside is a Bauhaus objet d'art: a stainless steel Tree of Life. It looks like an umbrella stand. A young woman student once said to me, "On moonlit nights in the spring Radcliffe girls dance around it, dropping ball bearings!"

Mies van der Rohe: I gave a series of lectures in Chicago in his memory. Before the first lecture my hosts were so kind as to drive me about Chicago to see his buildings. They were huge, skyscraper apartment buildings, great "functional" concrete and metal and glass structures, each housing thousands of persons. And expensive: for the most part condominiums. That word has always bothered me; for me it carries an inescapable suggestion of contraception. After that trip I realized that the suggestion is apt. Those condominiums are no place for kids. They are the greatest contribution to birth control since the sports car.

Paolo Soleri: There he is, that gifted man, making bony constructions in the American desert. I haven't seen one that I would remotely want to live in. But he has larger plans: for single, integrated structures, each to house hundreds of thousands of persons, a city. All human needs fulfilled in one great block. And "functional": one of Soleri's models shows such a construction that is simultaneously the spillway of a huge dam. That might be fun for Soleri. But can you imagine trying to live, even to raise children, in such a place?

All that dehumanizing architecture is getting us ready for Space Colonies. So one last but not least consideration concerning them: Who is to go to them? The power elite of our over-developed society? The highly affluent? Who else? Perhaps, having made piles of money out of war, smart bombs, nuclear weapons, they can find in the Space Colonies the refuge from which to watch the rest of humanity killing and maiming and poisoning and mutating one another – deciding eventually when it is safe to come back down.

Ed Taylor, the physicist, seems to be a nice guy (see McPhee: **The Curve of Binding Energy**). His parents were missionaries and pacifists, so when he went into making atom bombs he had a problem. First he set out to make the biggest, most effective fission bomb ever. It was going to be so horrifying as to end all possibility of war. It didn't. Then Ed Taylor took a new tack; he designed the smallest, most effective fission bomb, the poor man's atom bomb. That would spread so widely as surely to end all war. It didn't.

Ed Taylor ended up wishing he'd had nothing to do with any of that. So what's he into now? You've guessed it! It's to design the biggest space vehicle ever dreamed up, one on which persons could survive for many generations. And after that?

How about a farm, Ed Taylor? How about a horse?

Our sun has about another six billion years to run on the Main Sequence. That's a long time. If we take to serving life rather than death, if we can come to realize that maximizing profits is not the primary aim of human existence, if we could begin to take care of life – human, animal, plant; if we cultivated rather than devastated the Earth – then it could be a great place to live on and to enjoy – for the next six billion years! It's worth a try!

DAVID BROWER

***President, Friends of the Earth; initiator of "exhibit format" books such as* This is the American Earth**

Thank you for the chance to add my comment about the O'Neill Space Colonies to the comment of the brilliant people you have written to, even though I suspect you expected me to give a knee-jerk reaction, which I shall, because people who don't have good reflexes are in trouble, and my knee jerks when pounded.

Ever since I first discovered a fatal flaw in the logic of one of Edgar Rice Burroughs' Mars books (I once read them all), I have maintained a healthy skepticism ordinary people are supposed to maintain about attempts to achieve perpetual motion, or anything like it. That goes for the Mars lights that Burroughs invented that kept recycling their own light and thus needed no energy added. It goes for breeder reactors. And I am afraid it goes for the Space Colonies.

Owing to my preoccupation with problems on our friendly local planet, I have not had a chance to apply my sciolist's analytical capabilities to all the details of the colony scheme, but I am afraid I must remain in opposition unless Mr. O'Neill can guarantee that Murphy's Law will be inoperative on all his satellites, and that the Little Prince running each of them will never be overcome with what inevitably happens to leaders, sooner or later.

With Murphy's Law operative, I have grave misgivings about the colony gravity machine. Won't an awful lot of things start floating around willy nilly and getting hopelessly mixed up – people, crops, fertilizer, sidewalks, vehicles, and schoolteachers – when the rotating device that develops the gravity must be stopped for replacement of defective parts? I shall always remain suspicious of anyone who tries to mess with the Law of Gravity. Such a person might meddle next with the Second Law of Thermodynamics, and foul up the whole system.

As for the Little Prince, what happens if, upon your arrival at his colony, you ask him to take you to his leader, or his successor? Or he asks you. Colony politics needs to be thought through, because although engineers can build, politicians are at the switches.

Further aspects would worry me, I am sure, if the major argument against the scheme didn't make all other considerations academic. The major argument is this: In the last analysis, the scheme is born of despair, which, as C.P. Snow says, is a sin. Despair leads to Escapism. Let's not worry about what mischief we are wreaking with our one pass at the planet, Escapism says, because (a) we can get away for weekends, vacations, or sabbaticals, (b) we will be rewarded in heaven later on for putting up with the hell others have perpetrated for us on earth, (c) some remote island or continent will put enough space in between us and our tormentors, or (d) some other colony, on a (1) ready-built planet nearby, or (2) a custom-made contraption, pleasantly devoid of all the honing, perfecting forces of the very adversity that was solely responsible for making our present shape, senses, and spirit possible.

I would not wish to appear adamant. If Mr. O'Neill's colonies, after due energy accountancy and review of the environmental impact statement, prove more desirable than the present alternative, then let me be the first to place reservations, for the first colony, for all who would continue the atoms-for-peace/war experiment here. Let all of them, salesmen and customers, be aboard the maiden voyage, absolutely free of charge, with a bonus if they promise to stay away.

And let the rest of us stay here, on this poor old beautiful planet, plagued only by ourselves, and try in good heart to fix it. □

Box 428, Sausalito, California 94965

MICHAEL PHILLIPS

Co-founder Briarpatch Network, author of The Seven Laws of Money. *As POINT director, made the grant ($600) that paid for O'Neill's first Space Colony conference in 1974.*

My comments on the new planet are divided into two parts: (I) predictions that may be of interest to your readers, based on the three years of thought I have given this subject, and (II) current research directions of the International Committee for a New Planet.

Section I. Predictions

1. The milieu at the end of the end of this century: there will be two to five construction satellites in earth orbit with 10,000+ inhabitants on each, building a variety of space objects (such as power facilities and manufacturing stations), including a few planets for solar orbit. One or two of these solar orbiting planets will be functioning with populations of 40,000 or more. Most of these space objects will be oriented toward nation/cultures on Earth and will be affiliated with language groups such as English, Russian, and German, and also possibly Spanish, Japanese, and Chinese.

2. The scenario for the following quarter century, to 2026, will see the proliferation of planets in solar orbit based on a greater variety of peoples; some will be corporate creations – next-century equivalents of Xerox and Mitsubishi; some will be concepts groups such as Scientology, EST, and the Catholic Church; and some will be indescribable in current terminology, such as our own International Committee for a New Planet, which is made up of several cultural groups.

3. Interest in new planets will be primarily American. It fills our need for a new frontier. And as we did with the ecology fad, we will believe that the rest of the world thinks the way we do about new planets (they won't). Remember our "race" to the moon, which turned out to be us running alone.

4. The effect of the New Planet on people's minds will be of the same magnitude as were the adventures of Marco Polo and Columbus on the Western world. If there were a hierarchy of mind experiences ranging upward from opinions to attitudes to ideas to concepts, and higher to persuasions, religions, general philosophies, and cultural horizons, then there would be one still higher on the scale. I'll call it "human species perception." It is this level that was affected by Marco Polo and Columbus and it is this level that will be affected by the New Planet. I think a good case can be made for the position that these two men shaped the Reformation, science, and all subsequent Western political thought. I think it was their actions that fostered and developed the view we now refer to as The Perfectibility of Man doctrine. This doctrine of perfectibility was the basis of Bacon's and Newton's development of scientific technique. It also led to political doctrines ranging from Hobbes and Locke to Rousseau and Marx – and ultimately to the political experience we call constitutional democracy.

5. I think the nature of this new "human species perception" will be to understand and accept the findings of biology and archeology in the past century . . . so that if we are "perfectible," it must be in the context of our being an animal which evolved over hundreds of millions of years and which has 3 million years of direct experience in its current physical form. In addition, this evolutionary view will be subordinated to a new scientific finding emerging in the next quarter century: that we are a species with a single common culture that is 60,000 (or more) years old and has shaped us far more than the recent 6,000 years of recorded history.

6. We will come to learn of ourselves as descendants of a small (maybe 20 million worldwide) population of genetically homogeneous people who had a continuous cultural history of more than 50,000 years. This culture was partially absorbed into our city/non-nomadic culture since it was translated from the oral tradition directly into writing in our first written documents (Old Testament, Baghavad-gita, I Ching, the Books of the Dead, Euclid, Plato, Upanishads and Arabic algebraic works, etc.). The part that was not absorbed may today still be around us but ignored or partially destroyed (American Indians, gypsies, Africans, Shintoists, so-called "island primitives," and probably some esoteric gurus). With future research the language and experience of this 50,000 years of our cultural heritage will unfold and may dramatically shape all of our personal directions. The power of this tradition along with the immediacy of its influence will so drastically shape our view of our "perfectibility" that we will no longer look to governments or contemporary social structures to "perfect" us as we do now. We will begin long, arduous, personal (almost monastic) endurances to achieve a harmony with our "old" cultural heritage.

7. Science and the scientific method will become even more preeminent. Within 25 years 70 percent of all literate people will understand statistical testing and statistical "significance." The power of 300 years of science, which was empirically validated (completely!) by the first nuclear bomb and by our bringing back rocks from the moon, will be so completely accepted, absorbed, and understood that its primacy will spread rapidly to other fields. The fields most affected will be medicine and the political sciences (within these two broad categories I include biology, anthropology, and economics). In these fields high-quality empirical testing will become the norm, not the exception.

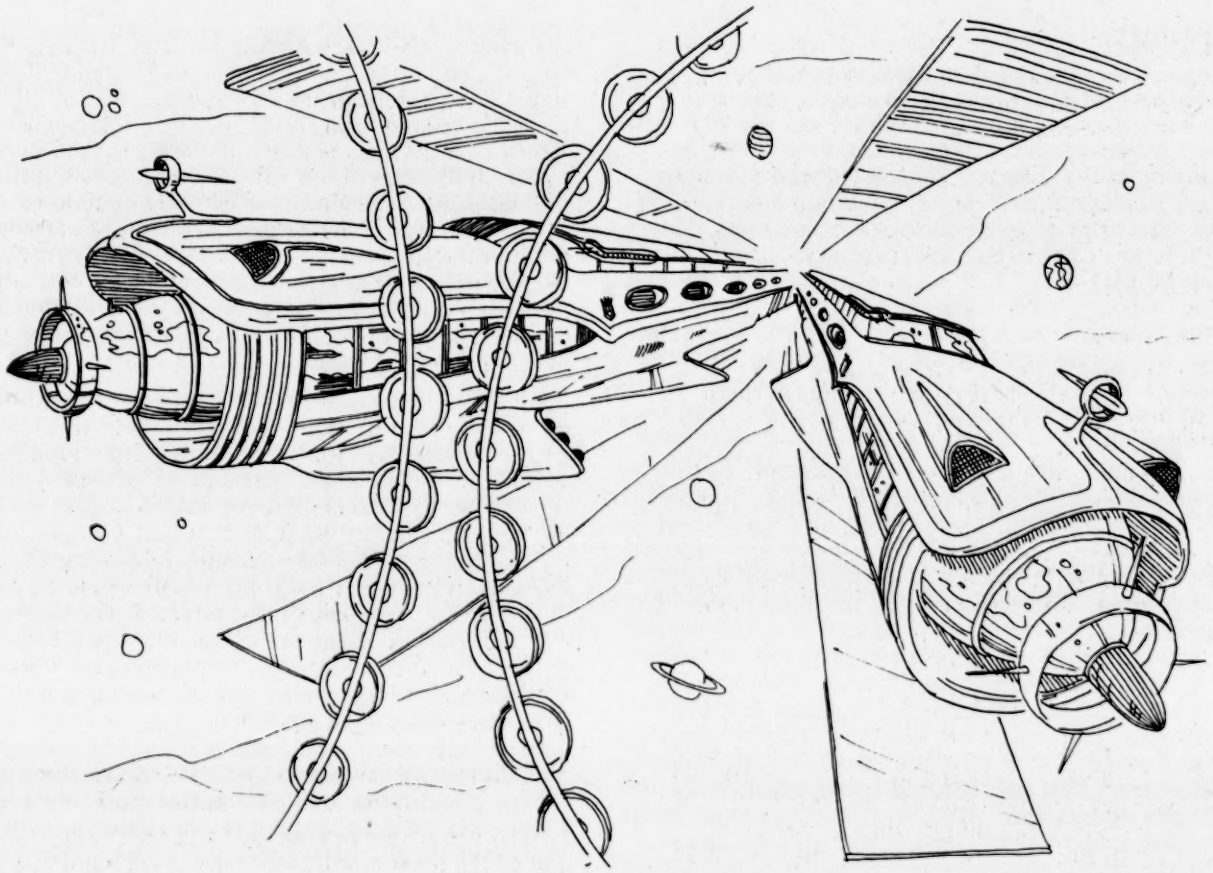
Section II. Current Research Directions of the International Committee for a New Planet

1. The end of the next decade will see the beginning of one of the most momentous changes in human behavior since the development of agriculture. It will be the beginning of the era of the "great Network." Computers are the reason, but they won't be visible and we won't call them computers (we don't call the phone system a computer, or talk about the computer-controlled elevator, but that's what they are!). We will just become media freaks as the new voice-operated interactive network terminal (or whatever) becomes more usable. Information will become free. Information has two incredible non-economic properties (as Dr. Peter Sherrill has taught me) 1) it is more valuable as more people have it; thus, the value of a single piece of information is not diminished when it is duplicated and distributed (for example . . . this article). 2) It is the basic source of all economic (and political) power. This will drastically alter all human institutions, ranging from power structures to work patterns, and most important, people's behavior will change (I won't go into detail here). Peter suggests an increase in psychopathy, particularly its milder forms such as manipulative role playing and the detached bureaucratic personality. I think there will be more Briarpatchism, people living on lowest incomes, with the fewest possessions, sharing resources, and emphasizing service to others.

Our research consists of interviewing, studying and testing people who have lived partially in this "future milieu": telephone operators, phone freaks, and real-time computer operators. Anthropology of the future.

2. We will support and encourage research in areas described in Section I, No. 6 above: the culture of the period 50,000 years before writing. Much of this research will be anthropological and archeological, but some of it will be scientific analysis of specific remaining artifacts, ranging from pre-Columbian knotted ropes to Tibetan stones, Shinto paper structures, Tarot images, and American Indian petroglyphs. The time scale on this work will be long and our Committee's efforts will be mainly supportive, looking for the occasional Rosetta Stone that will encourage other researchers.

3. We're going to get started on the technical work related to building a new planet. In less than 15 years NASA will be looking for a prime contractor to build Gerard O'Neill's working station. The airplane companies that became aerospace companies are no more appropriate for this than auto or railroad companies would have been for building rockets. So we can start building such a prime contractor now. I think the businesses that have the potential skill are in the underwater diving field, especially the ones doing the most difficult high-tech underwater work on the off-shore



Philip Garner

ANT FARM

Image technologists

SPACE COLONIES ARE TAIL FINS.

I've been doing some research into World War II technocracy and its legacy of pesticides, appliances, plastics, rockets, and other household items, especially the automobile, all in preparation for a book on cars by Ant Farm.

It seems almost everything we are living with today, from aerosol cans to McDonald's and the Interstate Highway System, has its roots in World War II. Harley Earl, who was the Vice President in charge of styling at General Motors until the mid-sixties once credited the airplane, particularly the slick wartime fighter planes, with being the greatest influence on car styling. The Cadillac tail fins, which Earl designed, were directly derivative from the Lockheed P-38 Lightning. (We found a good use for tail fins when we built the roadside Cadillac Ranch in 1974). G.M. used dream cars to introduce far out ideas like the tail fins, rocket ports, and wrap around windshields because they realized that the American consumer responded to IMAGES of technology in far greater numbers than they did to technological innovation. (Technological innovation was never G.M.'s best suit). But the images were a subtle way of selling an attitude that pervaded the war-time years, and has become synonomous with American Know-how. It's an attitude of machine idol, an infatuation with technology in general as a catch-all for problems both large and small. It can be seen in a little boy's love for cars, trucks, trains, planes, and anything shiny and fast. It was romanticized, mediaized, and sold American as the dream, a way of life, during the fifties. Not until the mid-sixties did we first recognize feedback on some of the fallout from our frenzied technological growth. Our pollution, our poisons, our congestion and our cancer rates can be measured statistically, but our loss in terms of alienation, attitude, and style of life can not.

So here I am, finally aware of my addiction to machines, my love of cars and all that sparkles and where it came from. I'm trying to come to terms with it. I don't want to become a 'return to the woods' anti-industrialist and yet I must become free from a generation of techno-conditioning. In the midst of this dilemma I open up **CoEvolution** and find Space Colonies – the ultimate machine fantasy. It will solve, you tell us: "The Energy Crisis, the Food Crisis, the Arms Race, and the population problem – in that order." Like my LSD fantasies of the late sixties it will have: "a Hawaiian climate in one and New England in the other, with the usual traffic of surf boards and skis between them." It sounds like a dream come true! It sounds like General Motors Futurama at the New York World's Fair of 1964: "In the distance, our eyes make out a jungle metropolis – dramatic proof of how mobility can help master even this tropical environment and turn it into a productive contributor to the world's marketplace." A reference to the Giant roadbuilder that makes 'instant highways' in jungles and other 'alien' environments.

Hey, wait a minute. That gives me a great idea. Why not give the Space Colony contract to General Motors? G.M. could stop building cars (a solution to the energy crisis) and put a war-time-like effort into Space. The assembly-line workers could again feel they were doing meaningful work and G.M.'s tremendous industrial capacity could be put to work building next year's Space Colony for the good of all mankind (those who can afford it that is). G.M.'s huge network of dealers could become space travel agents and in their service departments citizens could learn how to live in space, in simulators.

Well, that settles it. If you give G.M. the nod we will support Space Colonies 100%. To give you some incentive we are enclosing a stylist's rendering of the 1991 Space Colony by G.M. And even if they don't work they will be totally entertaining.

Good luck in the future,

–Chip Lord

---

oil rigs. A large well-run company, multicultural, in this field would be a very appropriate prime contractor to build planets in space. So I'm going to start work on creating such a company.

We welcome help from **CQ** readers on any of these last three specifics. No philosophical treatises please.

–International Committee
for a New Planet
330 Ellis Street
San Francisco, CA 94102

JOHN TODD

Biologist, co-founder of The New Alchemy Institute.
See also article on p. 54.

I have a perspective on the proposed space colonies that might be of use in the debate. I am a biological designer and for the past decade have been simulating a variety of aquatic and terrestrial ecosystems in contained spaces or "capsules." Some of them, like the tropical marine environment which my friends and I set up in a greenhouse at the Woods Hole Oceanographic Institution, were difficult to design. This "tropical" ecosystem was established to house the blennies and gobies (fishes) Bill McLarney and I were bringing back from Central America. Such a contained environment had to be designed well enough to permit the little marine fishes to breed, which is not an easy task. Fortunately, we were able to raise several generations in the north and learn something about them as I was interested in their sexual and social communication. We also simulated conditions of a local pond and an inshore marine area for studies of the effects of environmental perturbations on the social organization and behavior of a number of fish species.

From all this we learned that the social behavior of fishes and other animals can often be an extremely sensitive indicator of the health of a contained ecosystem and the highly social creatures have an intrinsic ability to bioassay their own environments. We also discovered that artificial environments were often unpredictable even when established as diverse ecosystems. Occasionally under conditions we did not fully comprehend, a particular alga species began to predominate, producing an antibiotic which killed the green and blue-green algae and a toxin which wiped out the molluscs and fishes. Sometimes an ecosystem became sick and we had to link it back up to the ecosystem from which it was derived originally. During my period at the Oceanographic Institution I didn't know too much about designing or using sub-ecosystems for self-regulation and biopurification, and was highly dependent upon technology. If a circulating pump blew or an air system quit, the next morning brought putrid smelling pools filled with dead animals floating belly-up on the surface.

At New Alchemy we have evolved biological design ideas to create food producing ecosystems seeded with organisms from around the world. They range in size from a tiny Chinese-type polyculture fish-raising system contained in a solar tube in my house to the Ark on Prince Edward Island which is a wind and solar-powered bioshelter containing a living area for people, a research facility, a family-sized food garden and commercial greenhouse and aquaculture components. The Ark, to be completed this summer, will be as close to a contained living space and biological entity as yet exists. It will be dependent upon its living elements. The Ark on a smaller scale has many of the attributes of a space colony, with one fundamental difference. Its gaseous, climatic and biological health is created through its couplings and linkages with the exterior environment. This fact is important and should be kept in mind.

After a decade of living intimately with designed ecosystems I am coming to know that nature is the result of several billion years of evolution, and that our understanding of whole systems is primitive. There are sensitive, unknown and unpredictable ecological regulating mechanisms far beyond the most exotic mathematical formulations of ecologists. When I read of schemes to create living spaces from scratch upon which human lives will be dependent for the air they breathe, for extrinsic protection from pathogens and for biopurification of wastes and food culture, I begin to visualize a titanic-like folly born of an engineering world view. At this point we don't know enough, being totally reliant on knowledge as well as physical subsidies from nature to survive on earth. In space there are no doors to open or neighbouring ecosystems to help correct our mistakes.

At New Alchemy we have established two backyard fish farm-greenhouses for a comparative look at different biological design strategies. Three summers ago both aquaculture ecosystems continuously produced massive blooms of green algae which, in turn, supported fishes as food, as providers of essential gases like oxygen and as detoxifiers of harmful ones like ammonia. Dense blooms, critical to the success of both systems, were maintained with tiny amounts of ground and roasted soybeans, a trick we picked up from a 1922 issue of a biological journal.

Two seasons ago one of the systems would not produce dense algae populations no matter what we did. It was a puzzle. Fish growth was reduced and the system was vulnerable to extremely low oxygen concentrations in the culture component. Some days the fish stuck their heads out of the water in search of a breatheable medium. The adjacent ecosystem housed in a geodesic dome produced excellent algae blooms.

This past growing season both of these backyard fish farms lost their algae blooms as well as their ability to produce oxygen to sustain large, rapidly growing populations of fishes. We had to use a number of management techniques including splashing water and having it flow through beds of oxygenating rooted aquatic plants to sustain these pond ecosystems. The fishes required larger amounts of supplemental feeds to grow. In ecological-economic terms the dilemma was pushing us in the wrong direction. Other systems were producing algae so that we could not explain away our problems as an "Act of God" although it's always tempting to do so.

What was wrong? Three years ago all was well. Then the next season one system failed and the following year so did the other. We started to track down sequential changes which might have been common to both. The explanation, or at least partial explanation, illustrates how little we know and bears on the space colony concept. Two years earlier I had planted a small bed of macrophytic or higher aquatic plants in the connected biopurification sub-ecosystem and water lilies in the supplemental food chain sub-ecosystem. The next year others did the same thing in the companion fish culture complex. The year they both produced algae in abundance was the year no higher aquatics were resident in the systems. The disappearance of massive blooms coincided with the introduction of the rooted plants and one or perhaps several of the aquatic plant species produced an antibiotic substance which severely curtailed reproduction of the algae in the fish culture component situated downstream. The antibiotic travelled in the flowing water to the main culture pond.

"Congratulations, Judy! It's a 12 pound 5 ounce male two headed calf!"

The higher plants had been placed in the biopurification section to help remove toxins and to provide oxygen for adjacent carbon dioxide producing shell-bacterial filters which have high oxygen demands. They did their job well, but elsewhere within the systems the effects were negative. In the future either the higher plants will have to be eliminated, which is unlikely as they serve many critical functions and are used as feeds for the Chinese White Amur fish downstream, or we shall have to break down the antibiotics which inhibit algae reproduction through some as yet unresolved biological means.

I don't mean to overload you with detail, the point being that little is known about chemical competition between higher aquatic plants and specific species of algae. The numbers of combinations of interactions are endless. A number of biologists have studied antibiotic activities between a few algae species in laboratories, but it's all tip of the iceberg stuff.

When one adds the relationships between fish species and algae, the matter becomes more complex and the interactions between the two might have some influence on the biogenesis of oxygen for contained atmospheres. A recent study in Poland by Maria Janusko has demonstrated that the composition and densities of fish species affected both algae production and algae species composition. Bighead Chinese carps, for example, which have a preference for microscopic animals as foods, caused blue-green algae to predominate, while the Silver Chinese carps, which are phytoplankton feeders, resulted in a shift towards the predomination of diatom algae in the experimental lakes. The whole ecology of the lakes was changed by a shift in fish species composition. Here we have a single scarcely understood example of webs that influence not only plant populations but gas production as well. Prediction is almost impossible – but in a space colony where it would be prudent to have the bulk of the oxygen ultimately generated from algae in ponds and carbon dioxide from soil-bacterial complexes, I would consider it unsafe to attempt to simulate liveable environments from our present biological knowledge. Let me elaborate.

A few years ago Howard Odum and Ariel Lugo put together contained microcosms (terraria) made up of components of the forest floor in a tropical rain forest. They were seeded with mineral soil, litter, forest floor herbs, algae and small animals to simulate some of the properties of that ecosystem. Most of the capsules were left on the forest floor but others were brought to controlled environment chambers at the Universities of Georgia and North Carolina.

The biotic communities of the terraria varied in the ratio of litter and consumers to plant producers. As a result, the carbon dioxide levels and gaseous equilibria within these contained ecosystems were different.

This is what Odum and Lugo concluded:

> This may be an important demonstration of the control of the atmosphere of the planet by the biotic components existing in the system. The physical properties of the atmosphere are a result of biological evolution as much as vice-versa.

In the space colonies the only long-range solution is to create ecosystems which create atmospheres upon which the vital support components, including humans, will depend. I suspect it will take decades or even centuries of seeding and reseeding organisms and varying of ratios of litter, soil, lakes, etc. to achieve a liveable environment. Here on earth our oceans act as a buffer protecting us from rapid and harmful misuses of landscapes . . . but only to a point. In the future we will come to realize the importance of wilderness areas on land as biological regulators of the planet and learn to respect them.

The space colony designers have planned to handle the atmosphere question in a variety of ways. All are highly technical, costly, subject to failure, engineering solutions. Initially, they intend to bring aboard supplies of oxygen-nitrogen mixes, if I understand them correctly.

O'Neill (page 13, Fall 1975 **CoEvolution Quarterly**) stated:

> Nitrogen constitutes 79% of our atmosphere on earth, but we do not use it in breathing: to provide an earth normal amount of nitrogen would cost us two ways in space colony construction, because structure masses would have to be increased to contain increased pressure, and because nitrogen would have to be imported from earth.

I am not sure how the ecosystems illustrated on page 7 of the **Quarterly** are going to like a nitrogen poor atmosphere. Certainly it would make the creation of ecologically-derived food producing culture systems difficult, and atmospheric nitrogen fixing plants might have a hard time.

O'Neill is more optimistic than I am although he acknowledges that semi-closed-cycle ecology will need prior verification. I think he is off the mark when he states that "Isolation and heat-sterilization can halt any runaway biological subsystem."

A resident population of some 10,000 individuals are going to have a difficult time making it in an area circumscribed within a mile's distance. This whole question of carrying capacity in space has been looked at before, albeit in a cursory fashion. During the hey-day of interest in space exploration (summer 1962) a symposium on the ecological aspects of space biology was convened at Oregon State University. Several ecologists present, including Howard Odum and Jack Myers, argued that space biology was presently confined to rather narrow disciplines tending to be simplistic and reductionistic and that if humanity were to explore space for any length of time we would have to take complex ecosystems with us. They went on to say that ecosystems were elegantly miniaturized and perfected with biocircuits, control functions, repair mechanisms, biopurifiers, gaseous regulators and had integrating abilities far beyond the wildest dreams of electrical engineers. Under regimes of total or overall accounting, including hidden subsidies, ecosystems were also efficient.

At the symposium Robert Beyers described eight artificial aquatic ecosystems conveying the message that balanced, steady-state ecosystems indeed could be contained. But his miniature ecosystems were in no way intended to produce end products such as human foods, nor was he trying to prove that the wastes from 10,000 people could be utilized.

Odum went one step further. Being optimistic, he stated that space environments for humans were possible, but he didn't let it go at that. He calculated a free energy budget for a self-maintaining, light supported, closed ecosystem at climax (stable state). His discussion which appeared in the **American Biology Teacher** [Vol. 25 (423-443) 1963] is worth reading. He feels that multiple seedings will be required, but that biological support in space can be developed given enough time. His estimates of the size of support ecosystems necessary for stable conditions are based upon his energetics and efficiencies calculations at various levels in the biological realm. The space required to support humans artificially makes one damn respectful of planet earth. He calculated that it would take about 2.5 acres of ecosystems combining water and land to sustain safely one person in a space colony. If my crude estimate of the first colony's potential biotic area of one hundred acres free of structures, machinery, storage and what have you is correct, Island One could support 40 people, not the 10,000 proposed by the exponents. If Odum is right that means that the other 9,960 people will have to bring along their own gases, food, and waste disposal units, and even at that they might tragically overload the colony.

I think that when people talk of colonizing space they really don't have any genuine perception of what it will involve. All the present support for space comes from earth and until we learn much, much more about contained ecosystems it will continue to do so. It won't be the kind of knowledge that a crash program of space biology will generate, but the very thinking about ecosystems in space potentially has the ability to move part of biology in the direction the New Alchemists are exploring.

I should like to end by stating my bias. The idea of moving nature into the cosmos is staggering. It may be the ultimate human folly, or it may be life's experiment in using us to extend itself. I do not believe that we as a species have in any way earned the Right of Passage. □

BROTHER DAVID STEINDL-RAST

Benedictine monk, founder of "Houses of Prayer" movement

You've done it again! If the publicity you are giving to O'Neill's idea of space colonies catches on, it could have an impact comparable to those first photographs of Earth from Space. Isn't it fascinating how quickly we moved from recognizing our planet as "Spaceship Earth" to designing an Earth Spaceship?

Let me first tell you what the idea did to me personally. When I picked up this issue of CQ, I was at best moderately interested. When I put it down, I knew that I had read some of the most important information of my lifetime. Here was a challenge. It would not leave me.

In fact, it has been growing on me ever since. Not so much the idea of shipping off our surplus population (that'll take a while and have its problems), but the possibility of tapping a practically inexhaustible source of energy by putting electric power plants in space. That does something to me far beyond its practical implications. It renews my experience of the abundance of nature. Yes, I remember the time when we thought of ocean and atmosphere as inexhaustible. But as we realized the implications of the term Spaceship Earth we ran the risk of thinking small instead of living frugally, which is quite a different thing. O'Neill's invention restores my childhood confidence in Mother Nature. And only now do I realize how important that is for our spiritual wellbeing.

Also, I suddenly find myself looking with different eyes at machines. Anything more complex than a pencil sharpener still makes me feel a bit uneasy. Is it going to break down? If so, I know I won't be able to fix it. Machines just isn't one of my talents. But for the first time the other day I felt something like respect, affection almost, when I watched that computer the teller was consulting at our local bank. After all, down here we can still make do with simple tools, if we are willing to pay the price and live austerely. In Space that's different. And that again is spiritually significant. I had long suspected that simplicity could not be reached by going back, but only by going forward, beyond complexity.

Of course, I see problems, too. One set of problems springs from the fact that we are dealing here with a controlled environment. It must be highly controlled if it is to work. But this entails the double danger of its becoming boring and vulnerable. I don't know enough about the technical aspects to assess the material vulnerability of so complex a system. (I hope it's not too likely that some schoolboy could inadvertently shoot a hole in the vault of the sky with his slingshot, and the air goes out as from a balloon.) The vulnerability I have in mind is of a different sort. When control is necessarily extensive, power accumulates and thus the danger of usurping this power. If scores of people have hijacked airplanes, how about hijacking a little world out there in Space?

Boredom is another shadow following control. How are we going to make room for the unpredictable, the wild, the surprise, for the untoward even, to save us from boredom? How much architectural variety sprang from the resistance a not fully conquered environment offered in the past. Now, that we can adopt any style we want, will every imitation be tried out? It's bad enough to come upon a Dutch windmill next to the Damascus gate in Jerusalem. I hope this kind of thing and the resulting boredom will be spared us in outer space. How boring, to make a space colony look like an island in the Bahamas or a township in New England! Why not make it look as much as possible like a space colony, and discover what that will be?

Another area of concern may still be connected with control: the inevitably high socialization of a space colony. One has to have lived as a member of a village community (or of a monastery, in fact) to appreciate the impact of social interdependence. Of one thing I am sure: there will have to be a sociological safety valve built into a space colony, a breathing space, a place to be alone for a time. A return trip to Earth might not quite be feasible every time you develop the kind of global cabin fever one must foresee. But there may be room for temporary hermits, say, on that belt of agricultural cylinders. There won't be need for someone to do a little hoeing of those space potatoes, will there? At any rate, monks ought to be able to teach us something in preparation for space colonizing. They have for quite a while experimented with intentional, often self-contained communities, and with the creative tension between cenobitic (communal) and eremitical (solitary) life.

But the sociological aspect of the need for solitude is still not the most important one in this context. There is a spiritual dimension to it. A space colony, even the largest possible one, will entail limitations of a kind we never come to know on earth. Now, there's one aspect of limitation which many people enjoy. It's what we find attractive about a compact car, a snug backpack, a ship where every inch of space is used to advantage. But the other side of limitation is a threat to us: every limitation points to our ultimate limitation, to death. We'll need solitude and silence to come to terms with death. All the more so in a setting where the limitations are too pronounced to hush death up, to gloss over it as we tend to do here. The hermit, as I see it, brings into society the lifegiving energy that flows from a radical confrontation with death. Ask Gerry O'Neill if he needs a starter group of space hermits. I think I'd know some volunteers.

Meanwhile, what can one do to help? What a rallying point space colonizing could be for our whole human family! Not because it can be done "without any sacrifice on our own part" as we are promised. The frontier is always an area of sacrifice, and the High Frontier demands higher sacrifices, because the stakes are higher. Sacrifices won't scare people off when the cause is inspiring. On the contrary. They'll rise to the challenge.

Suppose you collected – not yet money – only pledges of, say, $1,000 per person, conditionally. No one has to pay a penny unless and until the pledges add up to the total estimated cost. Only then does everybody pay. You could even make your contributors shareholders in this profitable enterprise. But we better let Mike Phillips work that out. Meanwhile let's make as much noise about space colonies as we can. If Columbus had gotten a little more publicity he wouldn't have been lobbying (a one man lobby) from 1485 to 1492. We can't afford seven years in 1976!

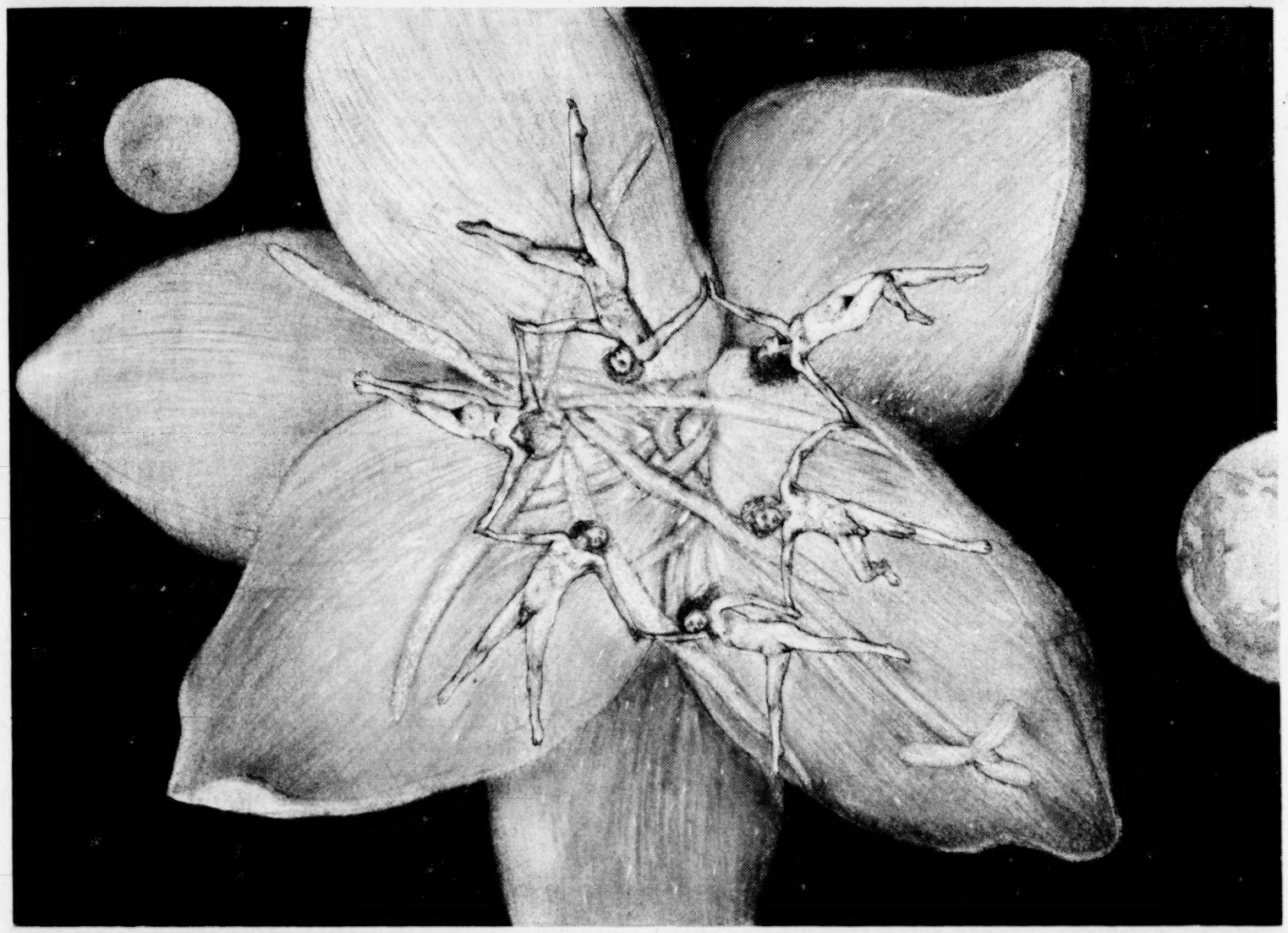
Info isn't heavy

. . . I want to help. Each man sees things in terms of his own craft; as an information system designer it occurs to me that one element of space colony construction has a very small gravity well transit penalty — this element is information. The available resources in space are energy and materials; the 'cook book' for transforming these into useful artifacts can be sent up from earth at a very modest cost using mature data processing and communications technologies. These technologies are on a rapidly declining cost curve.

Money and Politics

Building space colonies will be a very expensive venture; the break-even point for the investment is at least tens of years in the future. How to get money out of existing governments? A most interesting possibility is linked to disarmament. The U.S.A. and the U.S.S.R. have given considerable lip service to disarmament and to cooperation in space technology ventures. Here is a chance to get their money where their mouths are. The combined defense budgets of both countries exceed 170 billion dollars per year. O'Neill estimates that the space colonies project could be funded conservatively at 12.7 billion dollars per year; about 7% of the defense budgets. Funding a joint space colony project represents an interesting form of disarmament. Verification becomes much simpler — no need to count ICBMs, bombers, etc. Expenditure levels on the space colony project would be directly visible in terms of progress toward concrete goals. . . .

Dave Caulkins
Los Altos, California



Arthur Okamura

Planet parenthood

. . . I keep getting the vision of the planet as a plant which has flowered and wants to go to seed. Perhaps all the insanities of our time come basically from a frustrated planetary reproductive urge. . . .

Ramon Sender
Occidental, California

RICHARD BRAUTIGAN

***Poet, novelist, author of* Troutfishing in America**

OWLS

Hoot! Hoot! Hoot! Hoot!

I think for the time being, the remaining years of this century, we should limit our exploration of outer space and concentrate our creative energy and resources on taking care of our mother planet Earth and what lives here.

Owls hoot in the early Montana evening when the air is very still and floats the scent of pine trees.

I like this planet.

It's my home and I think it needs our attention and our love.

Let the stars wait a little while longer.

They are good at it.

We'll join them soon enough.

We'll be there.

Juvenile space

. . . Dixie and I have been discussing the space cities in the light of Margalef's ecological theory. We've considered that a healthy ecosystem, human or not, needs a dynamic patchwork of juvenile and mature sub-systems; the juvenile systems to promote evolutionary experiments, and the mature systems to remember the best results. Of course the systems will always be moving towards "climax" through succession, while occasional rejuvination will occur due to cataclysm (i.e., change too swift for life to swiftly adapt). Now, the state of Europe in pre-Columbian times was of a climaxing human ecology with dwindling frontiers of juvenility. Had the new world not been discovered, Europe would have certainly calcified to the point where it could not change rapidly enough, and a disaster would have probably nearly destroyed civilization. (The Great Plagues may very well have been such a disaster at an earlier time of "over-maturity." Bateson's notion that unused flexibility disappears is also relevant here.) But the New World was discovered, and opened up a new frontier both to exploitation and evolutionary experimentation. Democracy was one of the (apparently) successful experiments exported back to the old world; super-industrialization was another.

The analogy to our present dilemma should be obvious. World civilization has spread to the point where frontiers are scarce and flexibility is being gobbled up. In the Last W.E.C., Stewart, your proposal for "outlaw zones" was a recognition of the need for juvenile systems for necessary experiments to take place. But space cities provide a more expansive and open-ended frontier of juvenility to restore healthy balance to our culture. Our alternative, as we see it, is Apocalypse. To O'Neill and company we say, "Bravo!" and "Let's get on with it!" . . .

B. Alan Scrivener
Laredo, Texas

PETER WARSHALL

***Biologist, watershed consultant,* CQ *Natural History editor, author of* Septic Tank Practices**

My curiosity focuses on soil, Earth. Rather than say "10,000 humans are impossible to feed in a Space Colony," I would insist that O'Neill has drastically underestimated the problems of space agriculture.

I cannot judge the physics, but O'Neill's understanding of plant growth leaves me totally uninterested in this project. No details are needed. Just consider:

Comments like "the main reason for anything but a pure oxygen atmosphere is just fire protection." An enzyme (nitrogenase) is responsible for taking atmospheric nitrogen and changing it into high energy ammonia (NH_3). The ammonia is necessary for protein production. Here's the catch: *oxygen must be kept away from nitrogenase.* Too much oxygen, then no ammonia and no protein. It's hard enough on Earth to keep nitrogenase active (see below) without upping the amount in the atmosphere to 80%. O'Neill doesn't even mention nitrogen-fixing bacteria – the creatures that make all this possible.

O'Neill doesn't mention sources for the trace elements. For instance, molybdenum is needed to make nitrogenase.

O'Neill doesn't even mention the crucial elements like phosphorus. The universal energy "currency" of all living organisms is ATP (adenosine triphosphate).

O'Neill doesn't understand the simplest chemical processes involved in photosynthesis. For instance, photosynthetic compounds tend to mistake oxygen for carbon dioxide. When oxygen is incorporated in place of carbon dioxide, plants cannot produce carbohydrates. Remember, the early atmosphere of Earth had much more carbon dioxide. Plants (like soybeans) adapted to these heavy CO_2 atmospheres and still produce more protein in artificially high CO_2 environments.

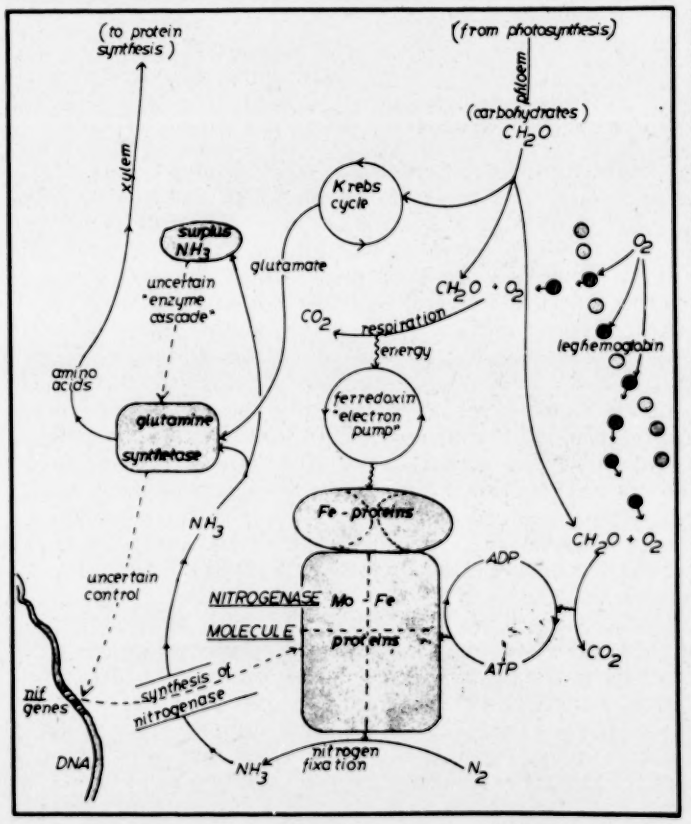
The two major elements needed for photosynthesis (carbon for carbohydrates) and nitrogen-fixation (nitrogen for proteins) are the scarcest mean elements according to O'Neill. How many times do we have to be told that life means organic life and organic life is just one great theatre of carbon molecules.

Not to sound too sour grapes but these CQ articles are prime examples of contemporary American schizophrenia: a technological romanticism totally removed from agricultural practicality.

The only benefit of Space Colony research might be the tiny slough off of relevant information about semi-closed-system agriculture. More sensibly the billions should be spent directly on Earth agriculture. (P.S. I am totally unimpressed by the scare tactic that we must exploit space or starve. Just another way to dilute energy into the BIG & TECHNO rather than the small and planetary.)

My own romance would make O'Neill and all potential space cadet(tes) serve five to ten years in a major Earth watershed (like the Hudson or Brahmaputra or Congo or Danube). After acquiring intimacy with the Earth, then, maybe, we should allow exportation of planet consciousness in outer space. To send techno-romantics as ambassadors of Earth Mind is abrasive to my Taoist soul.

I have included a simplified organic mandala of a small part of the nitrogen-fixation process. O'Neill might want to meditate on its implications for outer space food production.



By John H. Douglas (Science News, Vol. 108, Nov. 15, 1975)

Note that the whole process is a buffer system. Starting with water and carbon dioxide, fuel is made by photosynthesis. The fuel is used to alter nitrogen to ammonia. The genes are genes of nitrogen-fixing bacteria that live symbiotically with the plant. Any alteration in atmospheric conditions will change the total process. Four crucial elements (Carbon, Nitrogen, Hydrogen and Phosphorus) are scarce to nonexistent on the Moon.

Landscape and tools

. . . The prospect of industrial society migrating from the sensitive ecologies of the surface of Planet Earth to the ultimately tolerant vacuum of space is perhaps the most enticing of all technical fixes. The frosting on the cake is the assurance that we could even take a bit of Earth with us into the void, building terrestrial ecologies into our space habitats. If worse comes to worse, we could write Earth off as a total loss, and begin anew in our space colony mini-Earths. Unfortunately, there is no indication that the environmental problems afflicting Earth could be solved with any more ease in space. When the costs and technical problems of building Earth in space are taken into account, terrestrial ecologies in space colonies may very well be like taking a big teddy bear on a backpacking trip. . . .

The need for fabricated metal tools is the strongest and most tenacious umbilical between even the most self-sufficient back-to-the-earther and industrial society. The reason is deceptively simple: the set of all tools is an interdependent community.

For example, consider a moderately sized bulldozer required to move earth during the construction phase of the terrestrial habitat for a space colony. Even if we make the very generous assumption that the space colonies will be capable of producing bulldozers by themselves, what about the socket sets, torque wrenches, wheel pullers, and soldering irons required to maintain it? Or rubber hoses, spark plugs, lubricating oil, and Liquid Wrench? What about tools required to maintain other tools, like electronic calibration equipment? . . .

Not only does river water end up in the soil, but soil also ends up in river water. The process is called erosion. . . . Since rivers in a space colony would be closed systems, the natural processes of erosion and deposition would create potential for instability in stream courses, making extreme uncontrolled shifts in stream courses possible over time. . . . At some point, water will need to be reclaimed from the subsurface aquifer. Typically, nature does this through the springs that eventually become rivers. . . . It could be done through what civil engineers call subdrains, but that would amount to building a drainage system throughout the space colony for a process handled entirely by nature on Earth. . . .

To date, it has proven impossible to fully duplicate original ecologies on reclaimed strip mined land in the eastern United States. Soil chemistry, natural slopes, and the subtle relationships between elements of plant communities have proven impossible to recreate from scratch.

Mark Northcross
Costa Mesa, California

Phosphate!

. . .Stewart, listen:

Where is O'Neill going to get his phosphates? He and Drexler et. al. love to talk about iron and aluminum and hydrogen and all those lovely spacey hardwarey things but what about Leibig's Law of the Minimum — "A population is limited by whatever requisite is in shortest supply." Humans need phosphorus in the form of phosphates in their food. I haven't heard about any phosphorus on the moon, asteroids, L4 & 5, or even Jupiter. (Maybe there is; maybe nobody's talking about it.) So phosphates (among other things) will have to come from Earth. And we're in phosphate trouble. Best estimates put us out of phosphates between 2010 and 2030. (See Laing in **Not Man Apart**.). . .

Dr. Edward Passerini
University, Alabama

Cycles & pollution

. . . A perusal of the September 1970 issue of **Scientific American** will clearly outline the major problems to be overcome in establishing a *de novo* ecology. The following cycles will have to be "engineered" into the system: Weather (energy and water), Oxygen, Carbon, Nitrogen, Sulphur, and Minerals. This should really be self evident. In terms of Island One or Model III these cycles need to be considered in two contexts: (A) Controlled Agriculture and Food Supplies and (B) The Living Zone Biosphere. Controlling the 6 cycles in the Agricultural modules should be relatively easy, using modifications of the current hydroponics and greenhouse technologies. The establishment of a self sustaining Living Zone, however, poses much more serious problems, especially for Island One which gains most of its mass from lunar sources. The weather cycles will largely be controlled by the illumination and heating cycles engendered by the mirror systems, together with the kinetic forces generated by rotation. If one heats one side in a colony with threefold symmetry then there will be an evaporation-condensation cycle operating across the diameter of the colony. If one has alternating periods of light and dark over all surfaces simultaneously, then there will be severe fluctuations in the evaporation-cooling cycles and thunderstorms will probably result. The former system would probably give rise to heavy dews rather than rains. These patterns can probably be controlled by engineering.

The establishment of the O, C, N, S and of course, H (hydrogen) cycles largely depends on the establishment of proper soil conditions together with the requisite macro and micro flora (everything from worms to bacteriophage and back again). It seems to me that this will be a major problem, i.e., the conversion of lunar dust, which is predominantly volcanic rather than chondritic, into soil suitable for rapidly establishing a self-sustaining biosphere. The H, O, and C cycles are relatively easy in this respect, but the N and S cycles are more difficult. In this context Lynn Margulis' comment on the low pressure pure oxygen atmosphere ranks as one of the understatements of the year. All of these cycles are dependent on biotic components where enzymes and regulatory systems have evolved, in, and are best suited to, the chemical potentials and partial pressures of the environment on earth at the present time. The nitrogen cycle is not well understood in terms of quantification or systems analysis and neither is the sulphur cycle. We can talk glibly about nitrifiers and denitrifiers, but despite all of our molecular expertise, I suspect that our greenhouse man knows as much about building a self-contained ecosystem as do our ecologists.

Lastly, the mineral cycles contain sinks which are controlled by geological rather than biological processes. The main worry is the displacement of minerals and organic components, especially nitrogen, via leaching. Some mechanism must be made available for salvaging and redistributing these components from the rivers and lakes of the colony without disrupting large parts of the ecosystem. The facility with which this can be done will depend largely upon the kind of ecosystem established. The problems would be vastly different in a temperate colony as compared to a rain forest ecology. One of the principle differences would be in the rates of recycling and in the organic mass associated with detritus recycling.

One other thing that occurs to me also concerns cycling of mineral and organic components, the problems of epidemiology and chronic poisoning. Public health officials have long been aware of the potential problems encountered in sewage processing due to the potential recycling of spores and viruses which are resistant to 'normal' treatments. Agricultural scientists are currently very concerned about the possible concentration of heavy metals in agricultural produce when sewage sludges are recycled in the guise of fertilisers. I don't think I need to stress the possible deleterious effects that might occur from the accumulation of organic residues (not necessarily pesticides) such as nylon monomers, PVC, styrene, etc. in the top consumers (man) in this closed food chain. Even with industry outside the colony it will still be difficult to exclude casual contamination due to the usage of final products inside the main chamber.

I hope this doesn't sound too pessimistic because I think that many of these problems can be overcome by creative ingenuity. Also the expertise gained from building a biosphere from scratch, together with a compatible homosphere, will yield enormous benefits in knowledge for the vast majority who will remain on spaceship earth.

Alan Ball, Ph.D.
Biological Sciences, Brock University
St. Catherines, Ontario, Canada

Biology first

. . .We have to deal with the colony as a biological system, a wonderfully complex problem that O'Neill's groups have yet to give more than lip service to. We understand that as physicists they're not really capable of — or necessarily interested in — dealing with it, but the current strategy of ignoring that aspect and going on with the design until some biologists come along and take care of the problem is ridiculously naive. For one thing, it's the best way not to attract biologists to work with you. In our experience with the MIT group, almost no time was given to considering the biosystem since it wasn't a common interest and few people had any biological training. They had no faith in our necessarily inadequate descriptions of the complexities involved, and boundless faith in biologists' abilities to modify life forms to suit their needs.

Far from being tailored — or kluged — to fit the physical design of the colony, the ecosystem it will contain must to a large degree dictate that design. For instance, plants may grow in a nitrogen-free atmosphere because they get their nitrogen in a different form from bacteria in the soil. But where do you suppose the bacteria get it from? And as soon as you decide to dispense with the bacteria and fertilize directly with chemicals instead you've upset your minimum-energy equilibrium, and since you don't know what other functions plants (or something else in the food web) need those bacteria for, you're treading on shaky ground. This is tragic, for both the biologists who could have, in the design and eventual realization of space colonies, the perfect incentive and paradigm for exploring the Gaia hypothesis, and for the colony designers who, without an understanding of that hypothesis and its implications, will end up with an ugly and costly failure. . . .

Space colonization isn't something to rush into, and then be locked into, as a means to profit. Developed with care, as an end in itself, the space colony can be a most fertile inspiration, forcing/leading us to learn the meanings in the structure of communities, the balance of biological sufficiency, and the qualities of a sane technology, lest we export the amorphous, imbalanced insanities we live with now.

Consider that the building of worlds is the work of gods. Evolution is metamorphosis; when we leave Earth in a world we have created we will be literally and metaphorically leaving the cradle. The question is whether we break out of a ruin like a virus exploding from a shattered cell, or leave Earth as a child leaves a playpen, no longer needed but ready for the next sibling. The virus is a degenerate fragment that just replicates on; the child grows towards limits we haven't yet found.

Doug and Missy Mink
Brookline, Massachusetts

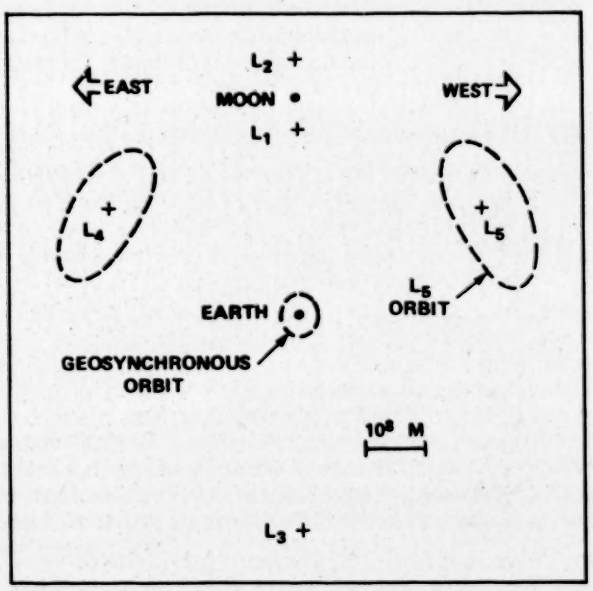
L-5 News

Much the best source for developments on Space Colony matters — better than us, better than O'Neill's newsletter (which is still worth getting, free from: Prof. Gerard K. O'Neill, Physics Dept., Box 708, Princeton, NJ 08540).

The L-5 News *is marked by its urgency. It comes out every couple weeks with its eight or so pages filled with aggressively researched reports of politicians newly converted, excerpts from speeches, quite interesting bite-size technical articles, and a certain amount of railing at foes. It's a bit un-self-critical and quick to perceive the world in terms of pro- and anti-L-5; or more simplistically, pro- and anti-technology. It is so opposite in opinion and tone to the Friends of the Earth publication* Not Man Apart *that the* L-5 News *could well be called "Man Apart." Otherwise it's growing fine.*

—SB

L-5 News
$20 /yr (student $10) from: L-5 Society
1620 North Park Ave.
Tucson, AZ 85719



WHAT ARE LIBRATION POINTS?

T. A. Heppenheimer

Our organization name is the L-5 Society, and our newsletter has stated that L-5 is one of the libration points in the Earth-Moon system. But what are libration points? The answer is that libration points are locations where a spacecraft may be placed so as always to remain in the same position with respect to the Earth and the Moon.

Suppose the Earth and Moon were fixed in space and did not move. Then a single libration point would exist at the point where the gravity fields of Earth and Moon cancel out. A body placed there would feel equal and opposite attractions from Earth and Moon, and so would stay fixed in place. But if the body were moved slightly, it would feel a slightly greater attraction from either Earth or Moon, and so would fall down, moving rapidly away from the libration point. That point, therefore, is unstable.

In reality, the Earth and Moon are in motion about their center of mass. (It is the Moon, of course, which does most of the moving.) This means that, in addition to the gravity of Earth and Moon, we must take account of the centrifugal force acting on a body in orbit. Libration points are then the points where these *three* effects cancel out: the two gravity fields, and the centrifugal force.

The French mathematician, Lagrange, in 1772, showed that there are five such points. Three of them lie on a line connecting the Earth and Moon; these are L-1, L-2, and L-3. They are unstable; a body placed there and moved slightly will tend to move away, though it will not usually crash directly onto the Earth or Moon. The other two are L-4 and L-5. They lie at equal distance from Earth and Moon, in the Moon's orbit, thus forming equilateral triangles with Earth and Moon. These points are stable. It is a curious fact that they are stable because the Moon is only 0.01215 times the total mass of Earth and Moon together. If the Moon were greater than 0.03852 times the total mass, L-4 and L-5 would be unstable.

The situation, however, is even more complex than this. The Sun is in the picture, and it disturbs the orbits of spacecraft and colonies. It turns out (from an extremely messy calculation done only in 1968) that with the Sun in the picture, a colony should be placed not directly at L-4 or L-5, but rather in an orbit around one of these points. The orbit keeps the colony about 90,000 miles from its central libration point. The orbit is roughly bean- or kidney-shaped. It may seem curious to speak of an orbit about a point. Actually, the colony is in orbit about the Earth, but the simplest way to describe the orbit is from the point of view of an observer sitting always at the libration point.

In the colonization project, the colonies are to be located in the vicinity of L-4 or L-5. L-2, located behind the Moon, is the site of a catcher vehicle, which collects mass shot up from the Moon by the mass-driver. L-1, between the Earth and Moon, is the location of a satellite power station, to provide power for the moon base. No use has yet been found for L-3. However, at L-3 the Moon is permanently eclipsed by the Earth, so it could serve as an asylum for people suffering from lycanthropy (werewolf tendencies).

•

VAPOR DEPOSITION OF MASSIVE STRUCTURES

Work done this summer suggests the possibility of fabricating space structures directly from vaporized metals. If proven out by further design work and by vacuum chamber experiments, it promises to provide a textbook example of the use of space conditions in processing, and may cut the cost of a colonization program by some tens of billions of dollars.

Fabrication of seamless hulls or hull segments would be a simple and useful application. The solar energy flux, vacuum, and lack of gravity in space make it easy to vaporize metal and direct it as a conical beam; metal plate of the desired strength and thickness can then be built up on a balloon-like form made of plastic film.

This technology seems applicable to both aluminum and steel alloys, to structures many kilometers in diameter, and to structures more complex than smooth balls. Because it requires little equipment and negligible labor, it promises to reduce the cost of some space structures to little more than the cost of raw material. It seems a fruitful area for further research.

Eric Drexler

•

A recent study at the Hudson Institute entitled The Next 200 Years in Space (NASA Bicentennial Planning) by Herman Kahn and William M. Brown, predicts the building of space communities and manufacturing facilities.

Those interested in the complete report should write to:

Hudson Institute
Quaker Ridge Road, Croton-on-Hudson
New York 10520
1 Rue du Bac, Paris 75007, France
1-11-46 Akasaka Minato-ku, Tokyo, Japan

Arab Space Program

While I am as potentially patriotic as the next person to his country of origin, I don't think we here in the U.S. have the surplus to put into such a project right away. And while we don't, OPEC does.

The oil rich nations have billions more than they themselves can spend, and are looking for some capital intensive scheme to start paying off about the time their oil runs out. They have the most to lose and the most to gain from a competitive, and clean, energy source. When you throw in abundant, exponential growth of both resource and demand, and long-range schemes, it becomes all the more inviting. They of course know first hand the economic-political clout in controlling an energy source. Big investment, Big profits. . .

If your idea about their space station program and our shuttle program is correct, what could follow is an alliance by U.S. and U.S.S.R., racing the first OPEC nation or nations who get started on this. A hassle over nationalism may come when unemployed aerospace engineers head in droves to the jobs waiting for them in Araby. I wonder if they would live in domed cities, many square miles in area, which had been built not only as protection from the desert clime, but also as models of the Colonies to be constructed in space.

M.A.W.D. Hoffman
Sturbridge, Massachusetts

ANNE NORCIA

Cartoonist

This cartoon is the summation of my commentary on the subject. . . I tend to feel abandoned faced with scientific jargon (the necessity of it aside) and become punchy when some obvious questions – to me – get passed over. A few of the remarks are from friends but most are mine. I realize some of the questions have already been discussed, but I threw them in anyway purely for compositional balance. By the way, the scientists are caricatures of no one in particular – just composite stereotypes.

MARC LE BRUN

CQ *Personal Computers editor*

Can we handle the idea? The Space Colonies require active public support, the sooner the better, if they are to become an actuality. Is this going to happen in a population which feels increasingly betrayed by the bright, shiny visions that have been held out to them, which, with historic inevitability, have failed to come to fruition? Is it politically pragmatic for those in control of the necessary public funds to back yet another pie-in-the-sky? Can those whose duty it is to reflect and represent the needs and desires of a constituency respond without prejudice to a project which is based on a recently discredited theme which seems to be so at odds to the temper of the times? Today, for many people, technology, material ambition, – these are sins of pride. Can a society of fledgling renunciates find a place in their hearts for non-trivial, monumental and exotic endeavors? Or does public opinion make that much difference in the face of obvious economic opportunity? In any case how the Colonies are received may reveal a great deal about the political, economic and cultural realities in which we attempt to find our "right livelihood."

Is it a good idea? Where we rub up against the limits of our environment it begins to pinch, to form a blister. By your "Law of Paradoxical Effects" the combination of two more-or-less closed systems (Earth and Colonies) results in a more-open system, both materially and in more ephemeral ways. A blister is a self-healing process. The question is: Do the Space Colonies lance the blister (and thereby interrupt the healing) or do they provide a bigger (and presumably better fitting) shoe? Is the immediacy with which we are beginning to feel environmental pressures an important factor in our growth towards a more mature world civilization? Will our expansion into solar space delay our coming to grips with important social and ethical questions for perhaps millenia? I believe the Colonies can provide some respite from some pressures, but humanity will always be grappling/growing with itself and the rest of the universe. Between frontier and homeland the issues will vary, but never the vitality of the struggle. Undoubtedly the Colonies will have a tremendous impact on our world and how we perceive it, perhaps we can anticipate and benefit from this impact deliberately.

Science fiction is, among other things, a literature of anticipation, a sort of dream rehearsal, and the idea of colonies in solar space has received attention from numerous writers. A common theme in many of their treatments is one which merits some consideration: the Space Colonies can become politically independent entities. Many of Larry Niven's tales of "Known Space" concern the proudly independent "Belters" who can't imagine why we "flatlanders" can stand to live at the bottom of a gravity well. Robert Heinlein's novel **The Moon Is a Harsh Mistress** tells how the moon colonists, the "Loonies," win their independence from the "earthworms" (with the help of a spontaneously sentient computer) simply by dropping rocks down that hole.

Now this may be like throwing a conceptual monkey-wrench into the machinery of public discussion, but I think it is vital to try to get a political as well as a pragmatic perspective on the Colonies. Initially we have just a handful of small colonies, strongly controlled by the investor/owner nation states. This is as inevitable as the financing of the great voyages of exploration by the European monarchies was several centuries ago. Just as inevitably the frontier will open out, a wilderness of space will be tamed in its wake, in the progression from Model I to Model III type Colonies, in a gradual shift from a geocentric to a heliocentric perspective. Somewhere along the line will come a time when entire generations will be born and die near L5 and elsewhere (providing some interesting difficulties in casting horoscopes, among other things). At that point large populations will of necessity feel a greater affinity with and allegiance to their "home" Colonies than they will to any nation on Earth.

There need not be anything like war between the Colonies and Earth, the benefits of cooperation seem to be too great, the fruits of conflict comparatively ghastly (although that hasn't stopped us yet). But it seems clear that once the Colonies become highly self-sufficient they will move from being a wholly-owned and controlled extension of Earth-based interests to a role as an independent producer/consumer.

A species (such as ourselves) on the verge of expanding beyond its planetary confines is thus faced with a number of challenging political issues: Can we for instance charter the Colonies in such a way as to recognise their inevitable independence? Or should there be some long-term repayment of Earth's resource investment by the individual colony? What about colonies built by several other colonies? Or perhaps each one should be dealt with individually, or perhaps the best policy is no policy at all . . . In any case we are faced with the interesting challenge of managing our own transition to a quite unprecedented way of life.

It seems likely (although not certain) that at some time our horizons will expand beyond those defined by the convex geometry of our favorite ball of dirt. If not now then later. Feasible or not, O'Neill's Space Colony proposals raise timely and significant questions, and are valuable for that reason alone. And besides, good ideas never die – they go away and sneak up on you when you aren't looking. □

GARRETT HARDIN

***Biologist, author of* Nature and Man's Fate; Exploring New Ethics for Survival; Stalking the Wild Taboo.**

Sure and it's an intoxicating vision Gerard O'Neill has given us, the dream of creating a shiny new world all of our own out toward the moon. How nice it would be to escape earth's population problems! But we had better be wary of intoxication, even by 100 Proof Technology. The trip may not be worth the hangover.

The image fails. This hangover would come before the trip – which probably would never take place. Let me explain why.

I'm not going to spend any time on the technical details, though I think Brother O'Neill has overlooked a few things. But he's done a pretty good job. An exciting job. Let's not carp at trivia.

On the economic side I think his vision fails. We must always measure proposals like his against Hitch's Rule, which says that a new enterprise always costs from two to twenty times as much as the most careful official estimate. The more exotic the technology, the greater the cost over-runs. O'Neill's space colonies are so exotic that the cost will surely go beyond Hitch's Rule.

So what? We're rich, aren't we? Yes, but not infinitely rich. For awhile, the cost of mammoth public works can be met by normal (though painful) adjustments in the economic system. But at a certain level, corrective feedbacks fail and the system goes into the destructive positive feedback mode. Uncontrollable inflation takes over; prices and taxes spiral upward out of reach. Attempts to evade the flopover point of the economic system introduce new evils.

History has something to tell us. In the 16th century the Papacy became intoxicated by the dream of building a monumental new Saint Peter's in Rome. Hitch's Rule soon ran the cost out of sight, and the Church had to finance the project by the sale of "indulgences" – advance forgiveness of sins yet to be committed. Parish priests pushed indulgences with all the subtlety of second-hand car salesmen on Saturday night television. Resentment of the hard sell led to the Reformation, and the Church never recovered its temporal power.

O'Neill says his space program will cost hundreds of billions of dollars. Applying Hitch's Rule we can be sure it will cost thousands of billions. Would such a venture push the economic system past the flopover point? Would O'Neill's space stations be civilization's Saint Peter's?

But there is a more serious criticism to be made. Let us, for the sake of argument, grant all of Professor O'Neill's technological and economic assumptions. The space station has now been completed. It is ready for occupancy. Question: Who is going to be permitted to move in?

Because of our powerful (though recently developed) tradition of integrating minority groups it is obvious that the complement of the spaceship would, if it were U.S. controlled, have to include blacks, whites, Puerto Ricans, Chicanos, Indians from Wounded Knee, Wallaceites, American Legionnaires, Weathermen and members of the Symbionese Liberation Army. If the emigrants were drawn from the whole world they would have to include Moslems, Hindus, Irish from both Belfast and Dublin, Greeks, Turks, Israeli, Arabs, Lebanese and Palestinians.

Some of the groups just mentioned are races, some are religions, some are political groups. It doesn't matter. Generically we can call them all tribes, where a tribe is defined as a group whose members pursue one code of ethics in their in-group relationships, and another code for their out-group.

A libration point spaceship is a precision instrument, far more delicate in its construction and far more vulnerable to sabotage than is our massive earth. How could such a fragile craft withstand the buffeting of warring tribes?

Paradoxically, the creators of such a spaceship would be psychologically least suited to be its permanent inhabitants. The Professor O'Neills of the world might make brief visits and inspection tours, but they could not tolerate the sort of life that permanent residents would have to pursue there. People of great originality and independence of spirit would be intolerable in the spaceship community, particularly if they belonged to different tribes.

For a libration point colony to survive it would have to have only one tribe on it. (This is a necessary but not sufficient condition, for even an initially uniform tribe may differentiate in time.) This means that the political system of the spaceship must include progress-stopping features from the first day people go on board. This means totalitarianism.

What group would be most suitable for this most recent Brave New World? Probably a religious group. There must be unity of thought and the acceptance of discipline. But the colonists couldn't be a bunch of Unitarians or Quakers, for these people regard the individual conscience as the best guide to action. Space colony existence would require something more like the Hutterites or the Mormons for its inhabitants. Scientists and college professors would, as residents, be disastrous.

The peopling of a spaceship creates an ironic problem for a society like ours. We worship "integration" and consent to forced diversification via "affirmative action." But integration could not be risked on this delicate vessel, for fear of sabotage and terrorism. Only "purification" would do.

How could we possibly sell a purification program to our people? If residence on a libration point colony was regarded as a plus, then every tribe would demand the right to live there. If it was regarded as a minus, no tribe would consent to be made the sacrificial goat. It seems unlikely that precisely one tribe would view residence as a plus, and all others see it as a minus. Yet that is what it would take to make a selective residence system work.

Let's go back to fundamentals. What was the motivation for this space colony proposal anyway? It was just this: to solve earth's population problems. But there is another way to do this: institute political controls of population here, setting and enforcing limits to the size of families. Technologically, this would be easy; politically, we haven't the foggiest notion how to do it. (We all are appalled by the thought of "a policeman under every bed.")

The principal attraction of the space colony proposal is that it apparently permits us to escape the necessity of political control. But, as we have just seen, this is only an apparent escape. In fact, because of the super-vulnerability of the spaceship to sabotage by tribal action, the most rigid political control would have to be instituted from the outset in the selection of the inhabitants and in their governance thereafter.

R. BUCKMINSTER FULLER

Design scientist, author of **Synergetics; Nine Chains to the Moon; Ideas and Integrities**

Conceptualizing realistically about humans as passengers on board 8,000-mile diameter Spaceship Earth traveling around the Sun at 60,000 miles an hour while flying formation with the Moon, which formation involves the 365 revolutions per each Sun circuit, and recalling that humans have always been born naked, helpless and ignorant though superbly equipped cerebrally, and endowed with hunger, thirst, curiosity and procreative instincts, it has been logical for humans to employ their minds' progressive discoveries of the cosmic principles governing all physical interattractions, interactions, reactions and intertransformings, and to use those principles in progressively organizing, to humanity's increasing advantage, the complex of cosmic principles interacting locally to produce their initial environment which most probably was that of a verdant south seas coral atoll – built by the coral on a volcano risen from ocean bottom ergo unoccupied by any animals, having only fish and birds as well as fruits, nuts and coconut milk. First the humans developed fish catching and carving tools, then rafts, dug-out canoes and paddles and then sailing outrigger canoes.

Reaching the greater islands and the mainland they developed animal skin, grass and leafwoven clothing and skin tents. They gradually entered safely into geographical areas where they would previously have perished. Slowly they learned to tame, then breed, cows, bullocks, water buffalo, horses and elephants. Next they developed oxen, then horse-drawn vehicles, then horseless vehicles, then ships of the sky. Then employing rocketry and packaging up the essential life-supporting environmental constituents of the biosphere they made sorties away from their mothership Earth and finally ferried over to their Sun orbiting-companion, the Moon.

Employing principles of optics, chemistry and electromagnetics, humans have now gained celestial information at the range of 11.5 billion light years in all directions around our Spaceship Earth. They have photographed equi-deeply into the microcosm. Macrocosmically they have located and photographed a billion galaxies of hundreds of billions of stars each. They have photophed atoms. Humans are now operating successfully in such vast and minute realms of scenario universe that 99.99% of their realistic activity is "invisible" to humans' limited range of direct sensing. Clearly, human beings are designed and equipped to operate in both ever larger and more incisive manner in respect to local universe and will for some time base their operations on their Mothership Earth.

I hear many people use my expression, Spaceship Earth, which I invented at the University of Michigan in 1951, yet I find almost all typesetters, editors and authors spelling Earth as "earth" with a small "e." I realize then that they are not thinking realistically about our world as being that of a planet whose name is equally well qualified to be capitalized as are those of Mars and Venus. People are going to keep on writing, earning their livings and enjoying kudos by glibly discussing space activities. I am confident, however, that they will also keep right on seeing the Sun "going down" in the evening and using the words "up" and "down" instead of using the words "in," "out" and "around," as used by the few who are working in cosmic realism. The word cosmic is frequently used to indicate non-realism. The vast majority are conditioned to think of the sky only as disorderly scenery. The only realism is cosmic. Cosmic includes all – macro-micro, – you and I.

I have now traveled around the world 39 times, never as a tourist but only in the course of my work. For the last quarter of a century, I have spent 9/10ths of my time away from my official home. People often say to me, "I do not see how you can stand so much travel." I answer, "You obviously don't know what you are doing. You and all of us are making 60,000 miles an hour around the Sun, which makes my kind of Earthian travel of utterly negligible magnitude." People ask me, "Where do you live?" I answer, "I do not mean to be rude or facetious, but I live on a little planet called Earth. I never leave home. My back yard has become greater and greater until it has proven to be a big sphere, and I can travel in any great circle direction and eventually find myself where I started, ergo: I never leave 'home'." If anyone asks, "How was the trip?" or "Where do you live?" they are not living in cosmic realism – they are "grooved" like an L.P. disc.

To all who are living in cosmic realism, the immediate inauguration of additional Earth-Moon, around-the-Sun flying formations of our team could not be more humanly normal. It is just as normal as a child coming out of its mother's womb, gradually learning to stand, then running around on its own legs.

So the whole project fails by reason of a pair of paradoxes. (1) The people who can conceive of this clever solution cannot be part of it. (2) The reasons for seeking the solution – refusal to accept political control – require that the solution be rejected.

What has just been carried out is an exercise in futurology. Every discipline has its distinctive techniques. We have just uncovered what is – or should be – a basic technique of futurology. Let me spell out the details.

In Euclidean geometry there is a technique called the *Reductio ad Absurdum* proof. A question is settled once and for all if it can be shown that the necessary assumptions lead to a logical absurdity (as that A both is, and is not, equal to B at the same time). A *Reductio ad Absurdum* proof is of overriding power; it puts an end to further investigation. (The only exception: one can look for errors in the proof itself.)

In futurology we have just seen the workings of a *Reductio ad Paradoxum* – let's call it RAP for short. If the very means of "solving" a problem thwarts the reason for using those means, then the "solution" is no solution. RAP overrides all other approaches – fancy technology, computer readouts and what-not. O'Neill's colonies run right up against a political *rapout*. There is no need to look further into problems of technical feasibility once we understand the political rapout.

Will this explication of the rapout put an end to the dream of libration point colonies? Most unlikely. Near the end of the 20th century we still have the Flat Earthers with us. From now on we will no doubt have the Librationists too. O'Neill may have given birth to a new religion.

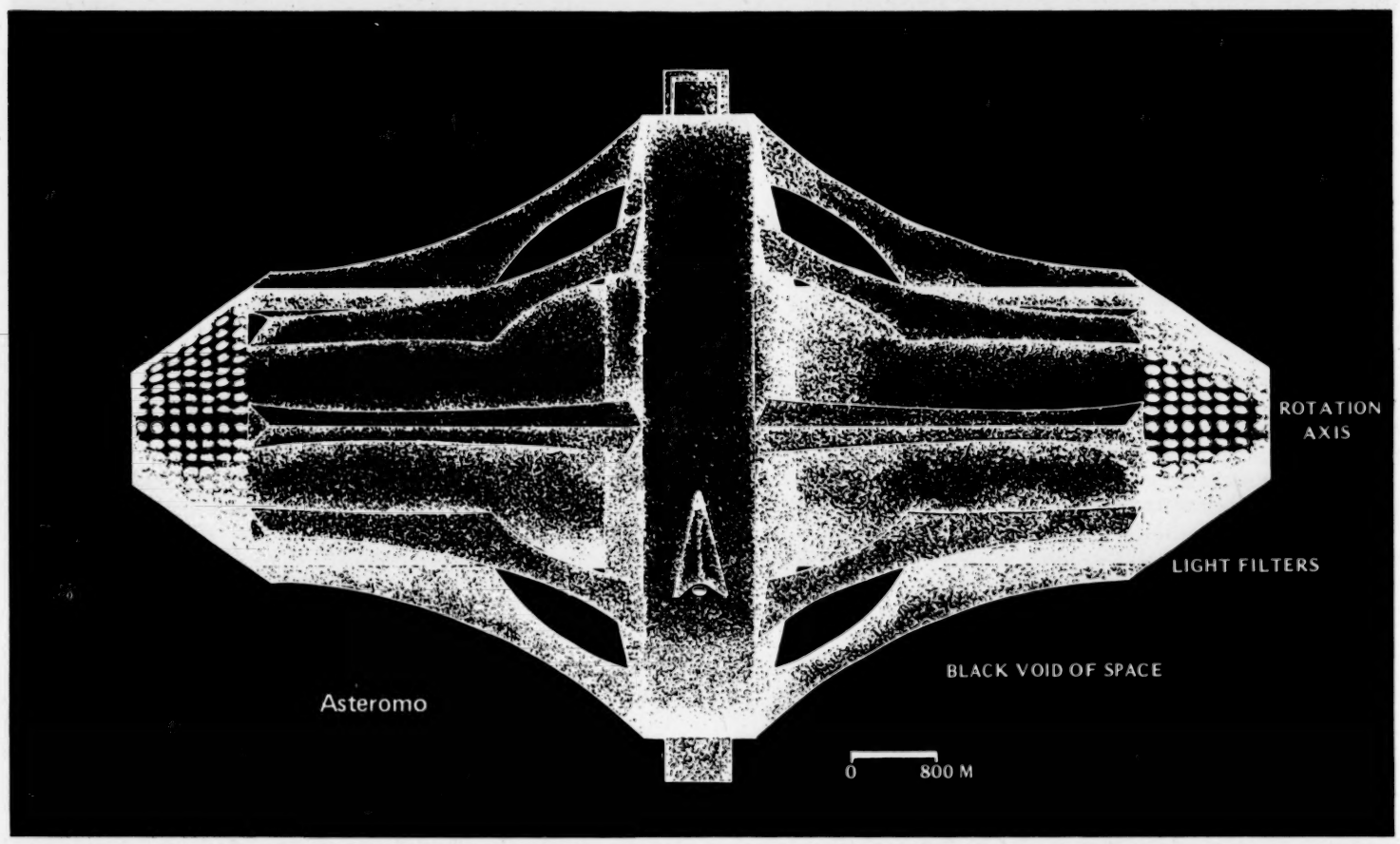
People don't like to have their dream-balloons punctured. The rapout here explained was first presented (not quite so explicitly) in a paper I published in the **Journal of Heredity** fifteen years before O'Neill's proposal. In my 1959 paper I criticized an earlier escapist proposal that was rather similar to O'Neill's. The way my paper was noticed was significant. My cost estimate, a minimum of three million dollars per emigrant from the earth, was frequently quoted. But the *Reductio ad Paradoxum* analysis was (so far as I know) never mentioned. Yet any cost estimate is only tentative, whereas a rapout is final and decisive.

Why should the least decisive result be cited while the most decisive one is ignored? I suspect it is because of our rather decent underlying love of "fair play." A decisive argument stops the game; so we pretend we never heard it, thus permitting the argument – now pointless – to go on. Our behavior does credit to our hearts, but not to our minds. If embarking on a hopelessly escapist program leads to the downfall of a civilization, a mere sense of fair play will be a poor excuse for having closed our eyes to the practical implications of a rapout.

Seed

. . . Analogies: Asimov's **Foundations**; the medieval Irish monks & others who preserved Latin learning while Europe fought over the Roman remains; the Atlantean legends; any plant packing its essence into tiny pods & scattering them on the verge of its autumnal death. Tell the colonists to carry an ark-load of life more than their support systems will require, & as many whole libraries as they can microfilm. I think it would make the rest of us feel somehow less threatened. . . .

Pierce Butler
Placitas, New Mexico



PAOLO SOLERI

***Urban visionary, author of* The City in the Image of Man; The Bridge Between Matter and Spirit is Matter Becoming Spirit**

On what can be defined the threshold to space "infinity," the human specie is going to make momentous decisions. Some of them will be unconscious and irreversible, and some will be conscious and "crucial." For one, if the venture is to be developed, we had better seek a consensus. In this size and kind of undertaking, it has to be a trans-national consensus and we must try to have a knowledgeable one. This will be impossible if the pioneers and promoters are themselves less than clear about the scope and impact of the enterprise.

What follows is a tossing in the air of a few points in the form of concerns. Consensus might have to be sought about them, and the sooner the better.

A. The technological concern. It is such that I am not well-equipped to tackle its technical underpinning and I, therefore, assume for the sake of what follows that we are capable of doing what the scientist and the technologist say can be done. At the same time, since its end-product will be a habitat, the technological concern is very close to my interest. But ultimately the technological concern is subservient to the eschatological concern and the habitat will have to be imprinted by it and imbued of it.

B. The politico-economic concern. It escapes me in many ways. Besides being not sufficiently knowledgeable on the matter, it is per se a tangled knot to which we respond or react in more and more "empirical" ways because more and more the inertial stresses pervading it seem to be beyond our limited wills and wisdom.

C. The eschatological concern. To my limited understanding, there will be a renewed religious unrest caused by the space probe and it will be an eschatological* concern which will embrace the following: the social, the environmental, the cultural, the ethical, the esthetic concerns. They are all directly operating upon the human condition together with the questions of health and genetic "preservation."

This concern will be mostly unspoken of, but will be also intentionally brushed under the rug of hard facts and techno-political imperatives. And yet, dear "fellow travelers," the stakes are frightfully high and we must, we ought, face what we are about to plan and to implement.

Under the pressure of scientific and technological "progress" stimulated by the space venture, the eschatological concern will give rise to new or pseudo new theological models.

Thus, as I can perceive it, the probe of life into space is ultimately not a technological or a political or economic problem but a theological one.

The eschatological implications of "space colonization" are most fundamental and critical and could be considered under the 3 following, but not necessarily equally important, titles: 1) The eschatological concern. The question itself of ultimate aim, the purposefulness of life, that is to say, the eschatological paradigm as such. 2) The genetic concern. The splitting of the human specie into "sub" species (see the pre-historical precedent) as a direct consequence of a space "invaded by humanity." 3) The urban concern. The space probe is the urban probe on "new grounds," therefore, the urban question looming every more large on the destiny of the specie.

Depending on how we will sense the 3 questions, we are in for hope or despair.

In despair:

1A) We see ourselves as the (well-worn) apprentice sorcerers incapable of halting our plunge into a technological "hubris" which will bring upon us more and more forcefully the wrath of our indignant Father, the Lord, and/or the merciless expulsion from nature's bosom.

2A) The human specie, abandoned by such Lord, or by Providence, or by instinctual wisdom, which under the stress of new (evil) environs will tear itself apart into inimical subspecies foreign to each other. Those will find their own nemesis in specialization, genetic and otherwise.

3A) The human specie will make an ever more compromising step into the urban syndrome, seen as the sum of all evil's syndrome, since space colonization will be directly informed by those conditions which are per se the definition of the urban context.

In hope:

1B) We are making (remaking?) a promethean commitment to the spirit, by unleashing it concretely from the gravi-

*ESCHATOLOGY? A study or science dealing with the ultimate destiny or purpose of mankind and the world. (Webster's Third New International Dictionary).

tational vise of the earth and, by so doing, opening the cosmos to "urbanization," that is to logos (see further).

2B) The human family recognizes its own genetic (and other) limitations and willfully seeks new ("morphologically") cognitive forms for the end of "outfitting" itself for the immense journey into the spirit via the flesh (mass-energy), and in the process going through a lengthy series of "transcendences" of its psychosomatic self.

3B) By stepping off the earthly landscape, man is turning by necessity (to be made into virtue) toward a frugality of environs and "hardware" which are specific to the urban condition to, and with one must add, ever more crucial transphysical longings. In sum, man will opt for the self-containment of his habitats, the inward orientation of them, the cooperative and inderdependent nature of the social and cultural texture, the high density of performance, the imperative of integrity and self-reliance and finally, the complexity and miniaturization of the milieu. The space city will, therefore, be unequivocally a test of how ready we are for the vertigo of a new momentous step toward the spirit.

I will deal with the hopeful triade, since there is where I stand and because by dealing with it I will also asystematically deal with the despair triade.

THE ESCHATOLOGICAL CONCERN

I look at it through a critique of the lifeboat metaphor and the carrying capacity thesis. I would offer the notion that their weakness does not come so much from a relativism peculiarly anchored to the consumerism ethos (gross national product) but that the scientific theory on which they stand is quite possibly unscientific, or better, a science which is basically a verification of facts (past) and which shies away from expectations that (to it) appear unscientific since they are only of the realm of the possible (feasible?).

If this were so, if the "science" of the carrying capacity (and the lifeboat ethic) is unscientifically applied, then its use is needlessly vicious. It is the viciousness of inflicting pain and death by the incongruous application of a paradigm.

Let's look at the carrying capacities as they seem to have developed.

The first living thing on this planet had, as a necessary support system, the whole existing cosmos, since only the existence of a specific if unknown cosmic balance made possible a specific if unknown solar system balance, that made possible on earth the appearance of a specific organism (one of them had to be the first). The cosmos in toto was the "territorial imperative" of a bacterial-like organism. No cosmos as such, no bacteria as such.

But at that moment already, or a bit sooner, things were getting "autonomous," that is to say, not purely deterministically generated. (Hopelessly prisoners of a totalitarian cosmic dictum). The solar system was "coming" to life and on earth, for instance, physical balances were interfered upon by physiological counterbalances. Oxygen was freed into the forming atmosphere by the initiative of living organisms, etc.

A first massive imploding of "territoriality" from cosmos to solar system, and specifically sun-earth-moon, was taking place. So it came to be that the "territoriality" for each organism was to be that amount of earth bulk which was the proportional fraction of the total "belonging" to it, to which was to be added a similarly defined fraction of the sun energy falling upon the earth and, in addition, relatively "infinitessimal" influences as moon-tides, cosmic radiation, etc.

If now one takes a look at the contemporary scene and one simplifies the model, one sees that for every human being is "needed" the presence and the "use" of a cone of matter defined by the radius of the earth and with a base measured by a circle upon the biosphere, atmosphere included, of let's say 100 acres. This gigantic mass to which must be added its share of sun energy is but an infinitesimal fraction of the "original mass" necessary for the advent of the first bacteria-like organism . . . and we begin to feel crowded!! But we begin to see also the "Providential" tendency of life toward frugality. Providential, since if it were to be otherwise, we would soon be face to face with the fatal dialectic of a self-parting universe (expanding) and a conscientization process that must abide to the fierce rules of shrinking carrying capacity and, face to face with lifeboat ethics, triage, et al. That is to say, that there would not be the rationale of evolutionary expanding capacity (extension of reach, contraction of needs), but an ontological wall made of undisputable and ultimate stop signs; a dying sun, the size and resources of the earth, and consequently life as a short fireworks of arrogance and opulence.

What if an even more incredible explosion of frugality is in store?

It is in the most frugal (and crowded) mode of all, in the brain of man, that powerful cognitions are working out more miracles of contraction and frugality (the Urban Effect is in full swing . . . see later) and, lo and behold, few hundreds of thousands of years after the invention of divinity, that prophecy of utter economy, the mind conceives a fully-lived, extra-terrestrial existence. The implosion in the brain of countless operations goes, at least potentially, for the numerical explosion of "ecologies" eventually unlimited in number, capable of sustaining and developing life. . . ad infinitum.

If for a moment, we assume that we will make the step and do it without diminishing man, then what do we have? An utterly new relationship with the world of "matter." We will literally mine the universe, the solar system at first, rearranging and processing matter into hollow urbis of all kinds of sizes and types and populations.

The order of the Christian God, "go and multiply," would see an unimaginable degree of realization and the carrying capacity of the cosmos would grow exponentially. With it, the lifeboat theory for all realistic purposes would be blown to bits since at best it would serve an acciduous and self-righteous society unwilling to get down to tasks and construct new boats one after the other, on and on "forever."

But why such explosion of life? For what purpose? The answer is theological. Before going into it, let's repeat what would happen to the "territorial imperative."

With the space venture the bulk of matter necessary for each person would dramatically shrink from the individual earthly cone, together with the corresponding ecological veneer and the sun energy, into a bulk on the scale of a home attached to an urban landscape to which would be added an open space of some acres or a fraction of an acre (and some energy from the sun, stars, to which the city might depend).

In other words, it would be as if the earth or any other celestial body were to be peeled off into successive skins,* each one of which would contain an "interiorized landscape" (cityscape) of minimal physical bulk. A characterization of the human environ as exponentially frugal. Thousands upon millions of hollow worlds, inner-oriented worlds because of locally produced gravity, would invade the universe (from as many points of it as there are conscious centers of it similar to earth.) Eventually, each galaxy would have the carrying capacity for four thousand millions of consciences (the earth today) billions of times over, a true explosion of consciousness throughout the physical universe.

What is so desirable in such model? On the personal level one could ask oneself if one would choose not to be born. If the answer is no, then to negate the birth of others, provided there is a carrying capacity, is rude to say the least. On the ontological level, it would seem clear that it is only with the intensification of reality by the presence and action of life, that "we" might eventually bring compassion and grace to the whole cosmos, the integrated universe.

The Theological Answer:

What is implied in this kind of process, insofar as life and consciousness can find as normative. It is implied that. . .

1) Consciousness is an unbelievably interiorizing stress.
2) Consciousness is an unbelievably complexifying stress.
3) Consciousness is an unbelievably miniaturizing stress.
4) Consciousness is an unbelievably frugalizing stress.
5) Consciousness is an unbelievably animating stress.
6) Consciousness is an unbelievably transcending stress.

***The earth as the last to be so treated, since the biosphere is "original," unique, precious and beautiful.**

7) Consciousness is an unbelievably urbanizing stress.
8) Consciousness is an unbelievably divinizing stress.

It is only half true that such are only the potential powers of consciousness, since a cursory survey of life's evolution is already, if coarsely, a demonstration of such power. Those are all "versions" of the fact that the eschatological imperative is pressed out from reality as an inescapable command: Do unto matter (the mass-energy universe) what you do unto yourself. Make it into "conscious matter" into logos. That is, demand and force out of an ephemerally conscious universe that which ultimately will be a child God of infinite conscience, infinite integrity, infinite love.

Once more, let's take a step back and then a jump ahead.

Once the biological has reached dimensional limits, the size of organic molecules, and furthermore, the biological has not been as yet supplanted by a "better" media, and since only that which can congruously plan and operate,* intellection, can also put more understanding, design and will in ever smaller amounts of mass-energy, space-time (miniaturization), it is in the "space city," the urbis et orbis in one, which is to be sought the next step toward logos. This is also and at the same time a statement of "feasibility" and of desirability, since to work against the process is ultimately to work against logos itself (and consequently against the spirit). This feasibility is imperatively demanding implementation. The open question remains. . . when?

It would then be for the sake of logos that life must free itself from the "earthly prison." And if it is possible for life to free itself from the earth, isn't it then a "mortal sin" not to do so? And isn't the fact that life could not even conceive of leaving the earth before the appearance of consciousness, and that thousands of years ago the first step toward this leaving expressed itself in metaphorical, that is religious form, a proof of sorts that it is the task of life and specifically of consciousness to do just so?

From a "territoriality" of the whole cosmos necessary for the appearance on our earth of the first living cell to the ecological cone necessary today for each creature populating the earth, to the minute "territoriality" of a space city, we can measure the powerful trend toward frugality and concurrently the not-less powerful opening of the whole universe itself to the spirit. Once upon a time a whole cosmos for one infinitely puny life, now eons later, now that intellection is grasping at the alchemy of matter and makes it deliver its latent energy and potential conscience, comes the possibility of mining the cosmos, of making a moon into "large numbers of earths," etc.

The ape, leashed by gravity to a tether pulling down toward the center of the earth, has its "territorial" imperative defined by the ecological capacity of the earth. With the appearance of the human mind the tether is (potentially) cut. The ecological capacity is (potentially) transferred from the limited earth to the endless universe.

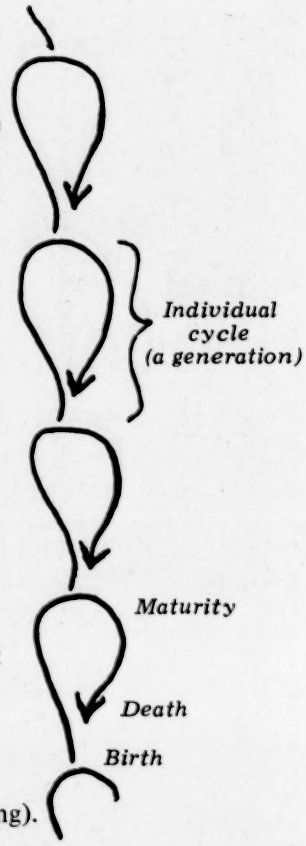
But for this potentially quasi-infinite growth of liveliness, two things seem to be indispensable: an eventually quasi-infinite growth of will and a quasi-infinite growth of reverence. Then divinity is expectant there in the future.

Two Considerations.

1) How much or how little we make of liveliness and consciousness-spirit is in a way not relevant since no matter what opinion we have of them, to have an opinion, any opinion is per se an identification of ourselves with them. One option we do not have is to give them up without giving up life itself. Then the fostering of them turns out to be a "law of nature" which tautological "block" is that the ultimate meaning of the ensuing process will not disclose itself before the exhaustion of itself. But this late disclosure is not due to secrecy but to "incompleteness." To reveal itself (to itself) before the "end," the Omega condition, would be an anticipation and as such they are an important exercise in futurism. But by necessity, those exercises fall short of target since the target is not there as yet, since it will be there only at the "end."

*That it can also operate incongruously is a well-known fact, therefore, our constant condition of emergency. But what if we were to loose our intellectual capacity?

2) A word about "compatibility." Each generation has its own environmental compatibility, that is to say, a person is hard put if he is asked to reject those conditions with which he has grown up. But each generation is piggy-backed on the preceeding one. The individual cycle demands a return to the infancy grounds (reentry into the mother, we call it the father), but for each infancy such grounds are the maturity grounds of the parents (the preceeding generation). This is providential since it secures both change and continuity. In fact, it would be difficult, if not impossible, to come up with a better "scheme." This dialectic of change versus continuity makes conflict inevitable. It follows that it would be not only unrealistic but down right unjust and cruel to want to thrust the "space move" upon the present generation as if it were a pleasure trip or a palatable prospect. But that could be so for our grandchildren. The fact remains that notwithstanding the incompatibility parameter, the parameters of territory-carrying capacity and environmental development are in constant flux (and growing).



2) THE SPLITTING OF THE HUMAN SPECIES INTO SUB-SPECIES

One of the most momentous outcomes of the space colonization successfully carried on will be the appearance of human mutants that will more fittingly perform in not just a new environment but in a variety of new environments. (We are children of our environment).

A most critical area of decision (or non-decision) is, therefore, the genetic pool area, and with it new conceptions of human values, justice, equity, hierarchy, fairness, etc. Are we able to withstand the thought that quite possibly, I would say inevitably, the human kind might become fractionalized (fractured?) into for instance, living fossils (the earthlings?), psycho-techno man (cyber), superman (an intellect-relayed multitude constituting a single creature?) similar but on a different ledge of evolution to the insect colony? (See further).

Since the future is not a process of deployment like the unrolling of a (sacred) scroll but instead a process of creation, nothing that we might conjecture or plan for, will ever turn out to be the future. Therefore, as it is quite possible that we never leave the earth, it is also quite possible that a polarization on this planet might eventually force upon us some "strange" variances from the human kind we are now accustomed (or resigned) to. That is to say, a genetic schism might be not only a consequence of, or peculiar to, a space colonization, but could be in fact the cause for a space colonization.

Isn't indeed what is going on now with the mystique of technology a kind of pilot work for a mutilation in the making, which in turn urges man into its space probe? Technological man, the *enfant terrible* of the 21st century, would be the mutant that as yet has to find a sound justification for his appearance. Now or soon, as a form, a container filling itself with purpose, he would cause life to extrude itself into a new set of parameters. A new universe authored by consciousness and its prowess in understanding, guiding, transforming, metamorphosizing. Are we in for a new radiant creature or are we in for life's abjection? The question is open and will be open for eons. In fact, for our earthly prospective, from our present, that possible radiant creature would be a "monster" anyhow since we could not withstand its sight (Bible). Whatever the case, we cannot escape the future and thus we might as well become conscious of some of its possibilities.

A) Since it will not make sense eventually to copy earth's environment "over there," environments more congruous

to the space situation will eventually define new morphological characters of fitness and response. Eventually, the physiological make-up might end its own usefulness, but well before such definitive and "radical" dismissal of the organic (see "Mass Transit - Mass Delusion"), we will probably mutate ourselves into cybers of sorts (we do already in the push-button syndrome).

B) Will there be in the meantime a transformation of the mother-lover. . . son-lover drive* in favor of a "scientific" intrusion in the immensely chancey but immensely rich genetic pool afforded by the bisexual mechanism? But might not this powerful and unpredictable (as yet) genetic pool be the best if not the only insurance policy against any cosmic emergency? Should we then dare to take such a step?

C) What will eventually make spaceman, besides the ability to think, like earthlings? And what if the thinking apparatuses become extravagantly different?

D) Will there be a "change of hearts" about slavery since sooner or later the notion of superior and inferior might be fostered among genetically different sub-species and peer groups? A "benign" version of such discrimination would make way for the earth as the living museum. The earthlings and their beautiful earth visited now and then by chartered space fraternities, a benign hypothesis in the restricted sense of doing away with violent confrontation, bloodshed and genocide. . .

We must beware and not make humility into insularity and eventually into bigotry. If it is true that man is unique, it is also true that he is uniquely isolated and confined (possibly isolated because confined). But what if he were to explode at first into the solar system, then into the Milky Way? Would not there be then good reasons for the specie to venture into new, unthinkable explorations of the psychosomatic potentials we are carriers of, in view of encounters with other centers of consciousness and grace?

If then one has to admit pure terror *vis a vis* the opening of a galactic trap door under one's humble but arrogant, venturesome but cowardly, compassionate but bigotted self, one must also not be blind to the possibly infinite radiance of the future on which such trap door is opened.

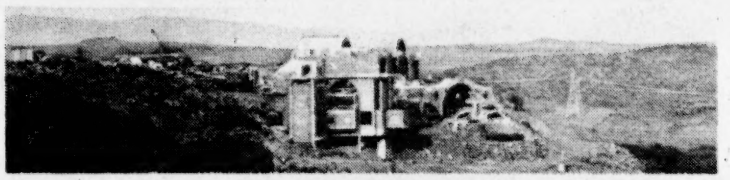
3) THE SPACE PROBE IS THE URBAN PROBE

Are we then really working at the creation of a Son God, the "masterpeice" of evolution, or are we deviated in the process and are we becoming the authors of a monster? To get an answer I think we have to consider that normative mode I call the Urban Effect.

It states that the transformation of the cosmos in the direction of the spirit is the Urban Effect. That is to say, the Urban Effect is an eschatological imperative. It states also, as a corollary, that divinity is the Urban Effect and third, that since the Urban Effect is as yet at an embryonic stage of development, neither is the city any closer today to what it will be (ought to be) nor is God any closer to being the monistic and absolute center of love we (religion) anticipate it to be. But there is an immanent Urban Effect which incarnates a limited divinity, the immanent God** (The God of the present).

This choice of terms, Urban Effect, divinity, God, is not casual or sensationalistic. It puts an eschatological thrust into the human condition by going at the tick of the human performance (where it becomes social, cultural, civilizing), the civic man. The civic man is not an experiment from which life might or will derive some advantages. It is instead the manifestation of the same kind of thrust that throughout evolution has and will keep the living stuff working upon raw matter at the cutting edge of conscientization.

The Urban Effect is the casual stress which forces the production of enclaves of consciousness, starting with the most ephemeral of them, the original micro-organism which



appeared on this earth thousands of millions of years ago. Those enclaves of consciousness are to incorporate eventually all of the universe in ways and expressions as multiple as are the world involved in the process and the time in which they perform. (There will occur then a further synthesis into the oneness of Omega). The frugal (miniaturizing) character of the process insures that the "end" will not find itself short of means by seeing that the equation end-means will exponentially grow to the final point where the nominator is near infinity and the denominator is near zero.

The enclaves of consciousness would eventually join together, thanks to the implosive force of the complexity-miniaturization paradigm which will be enabled by cognition to warp the cosmic laws into the "divine law."

It could be said that it is not so much the case of increasing the amount of spirit-consciousness that might exist scattered throughout the cosmos (the Taos) as the endowment of each particle, but it might be the case instead of the desegregation and conjunction of each particle of consciousness to one another by way of the Urban Effect and of the creative process which ensues from it.

This original atomized spirit, the atoms of consciousness, which can be conjectured to be composing the universe, this Alpha $1/10^{80}$ God is prisoner of its own iron cage of determinism together with the other $1/10^{80}$-1, and it is one of the 10^{80}* (polytheistic) deities of the pristine universe.

What is the logical thread that causes the Urban Effect to be the eschatological thrust? It is the common rule that any discipline (the eschatological thrust in the present case) has to be such as to foster that which has originated the conditions that have allowed for its birth. If the Urban Effect was the *causa prima* for the advent of consciousness-spirit, then the enhancement and the impregnation of the cosmos by conscience-spirit is dependent on how forcefully the Urban Effect goes on in multiplying and reinforcing itself throughout the cosmos.

There is a sort of premonitory situation which must be read even though it justly (but unjustly) sends shivers down one's own spine. It is written in the invertebrate, on land and sea societies of insects, in slime mold slugs, in the various (and infamous) ants or termites colonies, wasp and bee nests. They form aggregates of acting matter and why not thinking matter, perhaps comparable more to the mammal brain and its own specialized hierarchy than to anything else.

Up or down, side up, side down, gravity itself seems for the time being forgotten so much is the living matter inner-oriented, totally absorbed into itself, pure living matter, flesh, thinking flesh. They are the proto-conscious cities, anticipatory, if brutishly so, of urbis where the dependence on matter becomes less and less measured on bulk and more and more measured by arrangement and discrimination, complexity and miniaturization-intensity and transcendence.

If there is an eschatological guide to turn to for assistance in our decisions and actions, and if this guide is predicated on the emergence, via creative genesis, of the divine, then the breaking away from the earth's bondage is indispensable. It is not indispensable in the sense of being also sufficient, in fact this break away could end up being a run away from responsibility and "grace," but in the sense that there is no access to "full divinity" without the "concrete" intrusion of consciousness into all corners of the universe. Call it, if you like, redemption of matter whose sin is not to be as much as it ought to be: spirit. Or call it, as I prefer, the creation of a new and divine universe where each and all things are a radiant and transparent synopsis of each and all for each and all of all times and all places.** This assertion is not a breaking

*I refer to what I consider to be the Christian hypothesis about the fatherless birth of man presented in the myth of the Virgin Birth.

**This whole eschatological argument is absurd or blasphemous unless we are able to make a distinction and keep it constantly in mind, between the potential and the actual.

*The number of particles in the universe according to some calculations.

**A state where time and space have collapsed and, therefore, a condition of total resurrection. And resurrection is total or it is not.

of one's own bridges from (ecological-minded) "salvation" but it is a reinstatement of the concept that the bridge between matter and spirit is matter becoming spirit and the process cannot be halted at any accidental moment, the present.

That the notion of the breaking away from the earth is contemplated in most religions shows the anticipatory power of theological thinking. But usually this anticipation is not seen as entailing a physical migration of this life from the planet to other places. But if this is the interpretation, then the anticipation is wanting and the prophecy does not fit the eschatological grid. It would not suffice that the cosmos might sit in "adoration" around earthly magnets of intellection, as many of them might there be, scattered throughout it (thousands of millions)?! Intellection must move into the cosmos and consume it into consciousness, make it suffer the intellection of itself and so cause it to transcend itself and create the "not yet," the divine.

The reaching for the divine (the work of the spirit) demands this "inexhaustible" bridge of matter, all matter consuming itself into its own entelechy. But this is essentially the imperative of intensifying the performance of matter (mass-energy), that is to say, it is to cause the Urban Effect to become the universal concern, the rule and not the exception and, ultimately, cause not so much the City of God but instead and indeed the God-City, the Omega Urbis et Orbis . . . It might indeed be indispensable that our anthropomorphic god be reinvented into the God in the likeness of the city with the massive reservation that both the Urban Effect and the ultimate (entelechy) expression of it in divine terms are inconceivable, unimaginable for our limited conscience and grace.

To make a pale metaphor: to think of Omega *urbis et orbis* as a redeemed Detroit is comparable to the mystification one would be in for if one were to be presented with a tiny blob of tissue, an embryo, and were told that one beheld a beautiful, mature person. But the mystification would be even greater if the embryo turned out to be not of a human but of a fly. Detroit stays to the God-City as the embryo of a fly stays to the full-grown person. Between the two is the demonism of the evolutionary metamorphosis with its own cul-de-sac and its own triumphs.

Therefore, what we will weave in space is going to be a series of cities that will be adding new force, new degrees of eventfulness, new situations to the Urban Effect. One, quick to come to mind, is the riddance of the gravity burden (and as a consequence, genetic alterations). Another is the physical interiorization of the environs (and consequent psycho-social-cultural alterations), and another is the "crowding syndrome" coming to fruition with new force.

Crowding in this use of the term is not the bunching together of people, things and time, but the highly selective, discriminating coming together of disparate and per se less intense elements, in similar but not identical ways as it is done within an organism (plant, animal) or associations of organisms. "Crowded," living, durational events incredibly full of interdependent processes responding to the needs and the "hopes" of the organism. Since crowding is a divine attribute, co-presence, co-creation, understanding, knowledge, reverence, fullness, radiance,. . . then the Urban Effect (the crowding effect) is inexorably present whenever and wherever there is a thrust toward such condition of grace.

What then?

1) Space "migration" is in the human agenda.
2) Is space migration now a responsible act, a diversion, or pure escapism? A careful scheduling of our means, intellectual, ethical and otherwise, might show that the best defense against the squalor of the lifeboat theory and the carrying capacity "miscalculations" is the ultimate frugality of a life thrust, which can and if it really can, must also pervade the cosmos.
3) True frugality is the antithesis of mediocrity. (See "Relative Poverty" Summer '75 CQ). Therefore, a vivification of the cosmos which cannot but be frugal, is bound to move man on a higher ledge of the evolutionary pyramid.
4) To this end there is no escaping the need for a more reverential, urbane, civi-lized sense of the human experiment and, ultimately, the need for the eschatological vision of a universe in the process of self-divinization, the Urban Effect.

JULIA BRAND

CQ editor's mother, 72.

Space Colonies? Feasible, certainly. Inevitable, soon.

As you know, I thought years ago (20, 25?) we would have a space station before going to the moon. Gravity from centrifugal force, solar heat, algae for oxygen, recycling, etc., etc. O'Neill has extended & refined all those old ideas, added so many new ones, envisioned a beautiful and productive colony.

Remember the exhilaration of the moonshots & the chagrin when that marvelous assembly of trained and talented men was largely disbanded & the whole space endeavor diminished? Now at last a space shuttle is under way. I hope all will move faster and that at least one of O'Neill's colonies will get off the drawing board & into space. What marvelous possibilities!

Meanwhile my fascination holds for the far out probes to & beyond the planets. What wonderful surprises, what lovely mind stretching. Keep me posted. Remember what I asked you and the grandchildren. When I'm long gone, try saying to the wind, "Grandma, guess what!" & maybe. . . .

Better foolishness

Space Colonies are a good idea because they're bold but not Utopian. If my taxes are going to be spent on foolishness, this is the kind of foolishness I want them spent on. None of this trying to develop a frisbee that'll fling antipersonnel grenades or training porpoises to perform kamikaze missions.

I want to go. I need a home for my imagination. If I didn't go, how could I bear to sit down at the Space Cowboys (Cowpersons? Asteroidpunchers?) Bar and Grill in my old age and listen to the other geezers reminisce about slipping up to the end of Island One with Mary Lou to stare at the cosmos and doing it weightless for chrissakes. Sure did make your Betelgeuse, eh podner? Then they'd ask me what I did in the olden days before there were Golden Arches on the moon, and I'd have to hang my head and mumble, "I coulda gone, but my roots was too deep."

I want to help, particularly on food production/waste disposal or anything else my talents might be used for. I have my doubts about the immediate usefulness of lunar materials for growing food. Perhaps the best bet would be to start out depending on hydroponics and/or dehydrated food along with some algal reactors. (See Shelef, et al. "Algal Reactor for Life Support Systems," **Journal of the Sanitary Engineering Division**, ASCE, Vol. 96, No SA1, Proc. Paper 7105, February, 1970, pp. 91 - 110.) This algal reactor looks pretty good for use at L5 because of the availability of sunlight at L5. (Or the cheap energy available for powering electric Lucalux lamps as in the model used for this study.) Graham Caine's algae cycle might be useful if it works. See **Stop the 5 Gal. Flush!** *[EPILOG, p. 487.]*

If water is used for washing, or some kinds of manufacturing; perhaps a ground water recharge system or trickle filters would be useful for purifying it. See Bouwer's article in the previously cited journal for one recharge system design.

Maybe composting privies could be installed to provide for enrichment of the lunar "soil." There is also the question of bringing up the microorganisms (bacteria, viruses, nematodes, yeasts, etc.) necessary for establishing an Earth-like cycle. It might be wise to screen out some of the nastier pathogens, but I'm for keeping some garden variety diseases around to keep us on our toes.

Incidentally, a soils professor (Prof. Hole) who is a friend of mine once told our class, "There is no soil on the moon." His definition of soil is, "the portion of the environment providing water and nutrients for plants." Under this definition soils depend on their vegetation (or lack thereof) for their characteristics, and the oceans and atmosphere are soils. The fungi which provide water for the algae in lichens would be soils, hmm, maybe the algae are soils too, providing nutrients for the fungi. Until plants are grown on it the lunar sand/silt/clay isn't a "soil," as O'Neill called it.

Jonathan Beers
Madison, Wisconsin

DAVID SHETZLINE

Novelist, author of DeFord *and* Heckletooth 3.

No technical suggestions as yet, but may I (for the many who will choose to be left behind) offer some constructive – I trust – objections before feathering onto natural optimisms? (Or in these times, what remains of one's nat. ops.) First a confession:

My maternal grandfather was a second generation German-American whose eldest son signed up to be gassed in the First World War and whose youngest volunteered to be wounded in the Second. Grandfather saw virtually all modern devices Researched/Developed; and he believed, bought and personally used near every one. My father worked four decades as research engineer in the Bell Labs. Encouraged by such patriarchal models, I studied sciences at my first university. So this amateur is confident O'Neill's proposal will go. NASA seeks larger federal draw, detente is our metaphor, the Economy needs a bellwether other than arms, the Pentagon has been superbudgeted, etc. The time is over-ripe. One would have to be a rabbit, imagining Choice lies in the widening blackness between the oncoming headlights, to do anything but follow along behind the road proposed by the Space Colony energies. And in a sense this is exactly what I lament. An immediate future has been introduced which will fascinate and occupy at least one generation of Engineers, lock several generations of Laborers into steady toil, generate ongoing Capital Profits, maintain American Leadership, and open still another Damn Frontier.

Some fiction writers (O'Neill's scientist/novelist predecessor Tsiolkowsky) dream outward utopias while others (the prisoner/novelist Solzhenitsyn) reshuffle soap-operatic routines, seeking contemporary reforms. Certainly all are fascinated by any Grand Plan designed to keep us from further sliding down the socio-economic razorblade of life. Otherwise we are no closer to establishing the kingdom of god here on earth than two hundred years ago when some of our upperclass white male forefathers wrote in their diaries that they had. (Actually it was true for men of their persuasion.) We all need practical visions; the generalist in everyone is warmed by knowing at last Fulleresque System Structures will be given – literally – space to develop. I'm not sure what this promises the inner man, but no doubt divorce/bankruptcy/suicide will be amiably affected by the construction of human-made worlds proceeding from vestigial international cooperation. However, to begin anew, it may be necessary to confront our past and literally live it down within ourselves. Now and here. This is terribly frightening for everyone, as it suggests the grimmest possible course, politically, personally.

My own experience counsels that Engineer/Scientists are eminently practical folks who get things done. So it must seem extremely unkind (if not perverse) to insinuate a further Mechanical/Technological/Brave New will suck off a lot of energies, beckoning another generation outward toward quality equality and peace of mind. Nevertheless O'Neill's vision is quite elitist. Although he declaims the elitism of the Apollo Project and offers "the possibility of direct participation by large numbers of ordinary people," no matter who his workers are, the concept is elitist, no doubt has to be. If that is its only handicap, then in the profoundest sense, amen.

The Good Engineer, I suspect, from those who gave us the Great Pyramids, through da Vinci to Fermi, tended to shy from political considerations (although Fermi was very unsettled when the First SuperBomb's fireball seemed to overreach). O'Neill could be whistling when he suggests further development of such colonies would relieve the earth of exploitation by the industrial revolution and consequently open new frontiers to challenge the best and highest aspirations of the human race. His closing testimony reports: "Many correspondents refer to space colonization by analogy to the discovery of the new world or to the settlement a century ago of the American frontier." I feel much the yokel in underscoring that the discovery of the new world led to the virtual extermination of every one of its indigenous races, several of its species and the massively unequal distribution of most of its natural resources. South America is largely under fascist or military dictatorship. North America gave us the model for the first modern war – our Civil Meatgrinder – and has – since the closing of its American frontier – continued to expand that frontier anywhere CIA/Marines etc., *ad nauseam*.

Obviously Gerard O'Neill and all the good people he has drawn to his practical vision know that finding a new route around these old habits is the game. And somewhere in that game the past must be confirmed, its lesson understood. Then the present can be taken, seized. Before we go on to the future. Or at least at the same time. Big money always seems to ignore the lesson of the past and skip the present by insisting the future is our present.

Forgive me for offering what might seem to be merely some rustic lament yawped from some province of the mind. Of course space is antiseptic. There are no indigenous cowboys, Indians, Vietnamese, out there to be exploited. But when Project Independence goes so expensively/expansively into that virgin sweet light it will be its own indigenous race. And it will leave a hell of a lot of us behind, alone with existing mischiefs, quite powerless, unfunded, and perhaps in a poor position to help. Naturally, that is our challenge. And O'Neill has already done us great service: whether one will choose to be on the Colony or not, we are already out there or down here in our minds.

You invited a thousand words, I'm afraid I've run over without offering a single technological contribution. But try this: May Project Independence be sure to include at least one dozen each: excellent historians, crack economists, keen sociologists, to assist all aboard in matters of fine print whenever contracts are made with those folks the Project has had to align and bankroll itself. And may it never forget to write home.

Partial atmospheric pressure

. . . Cooking at 3 p.s.i. is going to be a slow affair. Some PV = nRT work to be exact, but water's going to boil at maybe 140°F.?? . . .

Jonathan Feiman
Riverside, Illinois

Use pressure cookers.

–SB

JOHN HOLT

Author of **How Children Fail; How Children Learn: What Do I Do Monday?**

It would take a book to discuss fully the many flaws and errors in Professor O'Neill's proposal for space colonies. Let me here mention a few.

First of all, the basic design of his cylinder is unworkable, for this reason. If the cylinder is rotating at a speed sufficient to produce centrifugal forces (*not* gravity, as they carelessly call it) equal to 1 g on the inner surface of the cylinder, then there will be equal or greater centrifugal forces on everything outside the cylinder which is rotating with it, i.e. the movable vanes which will supposedly reflect sunlight into the inside. Folded in flat, these vanes will experience along their entire length a centrifugal force equal to 1 g. Fully extended they will experience forces averaging about 4-5 g. But these vanes are supported only at the hinge end. To see how far this is from being possible, we have only to ask what is the longest structure that we can make on the earth's surface, parallel to the surface, and supported or cantilevered at one end. Hardly more than fifty yards, if that. O'Neill asks us to believe that with present technology we can make equivalent structures many miles long. Clearly, we will not do this in ten years, or a hundred; the odds are great that we will never do it.

If, then, we were to build one of O'Neill's cylinders and start it spinning, it would not be long before the vanes would begin to bend, fan out, and soon break off. We must ask ourselves, how is it possible that the by now tens or hundreds of thousands of "scientists" who have read of this proposal have not pointed out this elementary flaw? Either they have not seen it, because they did not want to, or because they are, quite literally, out of touch with reality, have lost the feel of real things. Or they have seen and not spoken, perhaps from fear, perhaps so as not to impede a project that would be good for "Science." Either way, they have shown that we dare not take their word about the benefits, feasibility, or costs of such a project. Despite their credentials they have shown themselves to be incompetent.

This defect in the design cannot be cured by supporting the vanes with cables. No cables are anywhere near strong enough to support many miles of their own length against such forces, to say nothing of the weight of the vanes. And if super cables, ten times the strength of any we have, should be invented, they could still not prevent these vanes, a mile or so wide, from sagging in the middle under the stress of centrifugal forces. Of course, the problem could be solved by having the reflecting vanes fixed in space, independent of the cylinder and not rotating with it. But there is no way with such an arrangement to have the day-night cycle which is the heart of O'Neill's plan.

Let me be clear at this point about what we can and cannot do. We can build cylinders in space as big as we want, if we do not try to put earth "gravity" and atmospheric pressure in them. Or, we can have earth "gravity" and pressure, if we keep the cylinders very small. But not with any technology we have now or are likely to have for a very long time, if ever, can we build the kind of cylinders O'Neill describes. We can make – have already made – human habitations in space. But they are, and must and will be, like submarines: they will never be like the surface of the earth.

This fundamental error of O'Neill & Co. – hereafter ONACO, though we could as well say CRASCO (Crackpot Scientists & Co.) or even MASCO, is only the first of a great many. Among others:

It is impossible, using available technology, or any likely to be available in the next generation, to refine metals and do other heavy industrial operations in space, or on the moon's surface, and any technology we ever develop to do it will be enormously expensive. The reason is that in a vacuum there is no medium to carry away excess heat. A rough figure often given is that it takes about 80 tons of water (and no one has estimated how many tons of air) to make one ton of steel.

The task of this water is simply to take heat, first, away from the steel, and then, away from the steel mill, and to dump it into the heat sink of the earth environment. What weight of radiating surface, and how disposed, would be required to dissipate heat at this rate into a vacuum? (It is another careless mistake to speak of space as being "cold"; it is neither

cold nor hot; objects in it may be cold or hot, depending on how much energy they receive and radiate.) The amount would be immense; at the temperatures at which humans can live and work, and at which presently existing machines are designed to operate, radiation is a very inefficient way to dissipate heat.

At any rate, the technologies to do such metal refining and shaping in a closed system surrounded by a vacuum do not exist, not in a pilot model, not on a laboratory scale, not on a drawing board, and probably not even in ONACO's imagination. In like manner, the technologies do not exist that would, in O'Neill's airy (no pun) phrase, "unlock" oxygen from the rocks on the moon. On earth's surface we break oxygen loose from metals by heating the metals to very high temperatures and then giving the oxygen an abundant supply of carbon to react with instead. On the moon, where would we get the carbon? How would we then free the oxygen from the carbon? And, in what sort of containers and heat exchangers, and with what sort of pumps, would we contain, cool, and finally compress these huge amounts of enormously hot gas?

Nor do we have, even on drawing boards, the technology to build on the moon's surface the materials launcher which is another vital part of ONACO's plan. We do not have linear motors capable of applying to a tracked vehicle the proposed accelerating force of 25+ g's and a decelerating force of 75+ g's, nor do we have speed measuring and controlling devices of the required sensitivity that would, and for long periods of time, withstand such forces, nor do we even have the vehicles themselves. Nor have we learned how to make a track level enough so that a vehicle could run smoothly on it at the required speed of about 4,000 miles per hour; the record on earth, and that over a very short distance, in a rocket powered sled, is only about 600 mph. Such a track would have to be heavily ballasted, not perched on flimsy supports as in ONACO's drawing. Nor have we any idea how these problems, difficult enough on earth, might be made more difficult by the moon's lighter gravity, different surface conditions, and, what is most important, enormous fluctuations in temperatures.

In these and many other respects ONACO have underestimated, by factors surely as great as ten and probably very much larger, the difficulty and expense of devising, building, testing, perfecting, and maintaining the devices needed to do the things they want to do. We do not yet know how to build a lunar habitat for even a half-dozen people; ONACO's plan will require a habitat that will house, and for long periods of time, hundreds and perhaps thousands.

In like manner, ONACO have grossly underestimated the weight of material that would be needed to build the space cylinder. From their words, and the artists' drawings, they seem to have no idea of the degree to which changing the scale of a problem changes the nature of the problem; they are like people who would try to build a 747 out of the same materials as a model airplane. Scale makes a great difference; to go from the 707 to the 747 we had to invent and make not only new metal alloys, but new machines to work those metals, among them forges many times larger than any that had existed.

Consider, for example, the effect of atmospheric pressure on the end of the cylinder. It is very much like the problem of building, on the earth's surface, a water tank, to be suspended from its upper rim, and to hold a 32 foot depth of water. If such a tank was to be ten yards wide, we could build it with fairly conventional means, heavy steel plates welded together. But if we try to imagine such a tank 50 yards wide, or 100 yards, and get some sense of the forces on the bottom, and their bending moment, we can see that much heavier construction, with massive stiffening beams, would be required, but ONACO are talking about such a tank more than a mile wide! In like manner the side walls of ONACO's cylinder would be subject to immense forces, both atmospheric and "gravitational;" it would take enormous amounts of reinforcing beams, both longitudinal and annular, to prevent the cylinder from bulging out into something more like a sphere, or even a disc.

Scale is also important in the matter of the microwave projection of energy that is another central part of ONACO's plan. No doubt we can transmit power through microwave energy on a laboratory scale, but that is not at all the same thing as doing it on an industrial scale. The technology to do that does not yet exist. And if it did, or when it does, how big will be the target area on earth to which this energy is projected? More important, at such distances, through what kind of feedback mechanisms will the projector be kept on target? And more important yet, suppose these mechanisms break down – things do break down – and this energy beam, probably close to what we might call a Death Ray, starts to wander around on the earth's surface. What then?

As to the cylinders themselves, even if we could solve the vane problem and so get a cycle of day and night, which we can't, we would still not get an earth-like environment. What about rain? To get rain at night, the relative humidity would have to be very close to 100%, certainly far above any level of comfort. What about balance? The weight in the cylinder would have to be kept in balance, not only around the axis of rotation but also down the long axis. Otherwise the cylinder would begin to rotate eccentrically, or to wobble. There being no correcting forces the cylinders would be in unstable equilibrium, and these motions, once started, would tend to increase. For that matter, an object at L5 is itself in unstable equilibrium; there are no forces tending to keep it there, and since any movement will bring it into the gravitational fields of earth or moon, once it starts to move it will keep moving. And what about wind within the cylinders? Since, if the vanes could be made to work (which they can't), the end of the cylinder nearest the sun would always get much less sun than the far end, and would hence be colder, what sort of air currents might be set up? And how long would it take to establish a stable biosphere, and how would it be done? O'Neill's brief remarks about doing away with unwanted pests show that ONACO is thoroughly ignorant in this area. And even if some miracle technology of the distant future, as yet undreamed of, could solve all these problems, it would not produce an environment like the surface of the Earth. Living there would not be like living on Earth, only nicer; it would be like living in the inside of a big rotating cylinder with mirrors outside reflecting in sunlight. Who would choose to spend the rest of his life there? Not me, for sure. Only the starving and desperate – and for them, no such palatial accomodations would be needed.

Space is not Heaven. It is not even Disneyland. It is an environment as hostile and deadly as the core of a nuclear reactor or the inside of a tank of nerve gas. In time, we will probably learn how to move around in it a bit more and do a few more things in it. But Earth's major problems will have to be solved on Earth.

Technical debate

John Holt's above letter to us has been answered hotly by one T.A. Heppenheimer of the Center for Space Science in Fountain Valley, California, writing to someone named Cheston at Georgetown University in D.C. John Holt sent Heppenheimer's letter to us, along with his own (Holt's) counter-remarks, which were addressed originally to Senator Edward Kennedy. A peculiar form of private publishing, all this, but a fascinating debate. I have trimmed preambles and shuffled the retorts and counter-retorts together.

Heppenheimer begins:

Before proceeding to address the technical points, I believe it is first worth-while to consider points of theology. There are a number of places in the paper where the author makes assertions which can only be described as theological, as articles of faith. These are the statements that space is insuperably hostile, that it can be of no significant value to man, that we must solve our problems on Earth, and the like. There is an alternate position, which is equally theological. This is compounded of assertions such as "the earth is the cradle of man, but man cannot live in the cradle forever," or the "man's colonization of space is as significant as the colonization of the land by aquatic animals in the Cambrian Epoch," or that "man's imagination and daring can overcome any limits."

I feel the pessimistic theology is naive, and is irresponsible. In a time of challenge to the foundations of our industrial civilization, it ill-behooves us to dismiss major technologies out of hand. But non-theological pessimism is valuable if it leads us to examine carefully proposed solutions and to prove critically for weak points. The optimistic theology is also naive, and may lead us to underestimate the obstacles which obstruct a difficult project. But a type of optimism is useful in that it may lead us not to be daunted by initial difficulties, but instead to seek to apply ingenuity and resourcefulness so as to overcome difficult problems.

I personally feel that the most fruitful attitude is not one of optimism or of pessimism, but of what might be called "critical ingenuity." That is, one must seek to be critical, yet to buttress one's criticisms with solid technical reasoning drawn from a multitude of fields. At the same time, one must have sufficient command of the pertinent technical fields as to be able to recognize what problems are truly difficult, what problems will readily yield to intelligent design. Then, faced with such a true difficulty, one must seek to cut to the center of the problem, to lay bare the core of the difficulty, and to apply the pertinent sciences so as to propose a solution.

With these comments, then, I will try to attend to the dozen or so chief objections which the author has made.

(1) The mirrors of the cylinders. These are exposed to at most about 2 g, not 4 - 5.[1] Structurally, they consist of lightweight supports for extremely lightweight reflectors, for example of aluminized mylar.[2] There is no reason to build them as cantilever beams. On the contrary, one can easily arrange a system of tension-line supports to guy the reflectors.[3] Nor is it necessary to fold them in and out each day.[4] It may well be preferable to build the mirror support structures as fixed assemblages, on which mirror panels are mounted in the fashion of venetian blinds.[5] They would then be tilted so as to give partial or total illumination, or to illuminate only a part of the colony. In short, the problem of mirror design, so far from being an insuperable obstacle, is the sort of problem I would cheerfully assign to a sophomore course in strength of materials.[6]

Holt replies:

1. Heppenheimer is mistaken here. The centrifugal forces on the reflecting mirrors will depend on the design of the cylinders. Given certain designs, these forces might be as low as 2g; given others, they could be as high as 5g's or even higher. Most of O'Neill's articles about space colonies have described, and the accompanying illustrations have shown, cylinders four or more times as long as wide, with mirrors long enough to reflect sunlight into the full length of the cylinder. As the accompanying sketch shows, for

such a cylinder the forces acting on the reflecting mirror when in the fully open (i.e. 45 degrees) position will range from 1g at the end nearest the cylinder to 9g's at the extreme end, with a 5g average. If the ratio of length to width of the cylinder is greater, these forces will be correspondingly greater.

2. Heppenheimer has missed the point here. What counts is not the lightness of the reflecting material, but its rigidity. Since all of these mirrored surfaces will experience "gravitational" forces greater than 1g, they must be rigid enough to remain flat under these stresses, or they will be useless as reflecting mirrors. When we consider the size of these mirrors — for some cylinder designs they might be ten or more miles long and two miles wide — it is clear that the supporting structures which will be needed to give the necessary flatness will not be simple or light.

3. In the first place, none of the drawings and sketches which have accompanied O'Neill's articles to date have shown or indicated any such cables. In the second place, to support the kind of structures mentioned in No. 2 above, a veritable forest of cables would be necessary. In the third place, if we imagine the 2 mile x 8 mile cylinder that O'Neill often talks about, the cables to support the ends of the mirrors would have to be about eight miles long. If, as would be the case in such structures, the average force on such a cable was 5g's, we would require a cable strong enough to support, on the surface of the Earth, 40 miles of its own length, plus five times the weight of the much heavier mirror and supporting structure. The strongest cables we now have will support about 35 miles of their own length — but that's all. The four or five times stronger cables we need do not exist. It could be said in reply that there is no need to design the space colonies in this way. But this is the way that O'Neill, in article after article for a year and a half now, has proposed that they be designed. And I must ask again, if the scientific community cannot see, or seeing, will not speak publicly about a mistake as great as this, how much can we trust them to tell us about other mistakes?

4. No, it is not necessary. But this is what O'Neill was for a long time proposing, to give an Earth-like illusion of the sun rising and setting. 5. Yes, but if the mirrors are attached to the ship and rotate with it, the problem of the centrifugal forces remains. If the mirrors are not attached to the ship, a new and equally difficult problem arises — how to maintain their position with respect to each other. As for the venetian blinds, that would probably work, but at the cost of much of the supposedly Earth's-surface appearance of the environment. 6. Perhaps — as long as someone rather more skeptical, and with a surer feel for the reality of things, was there to correct the papers.

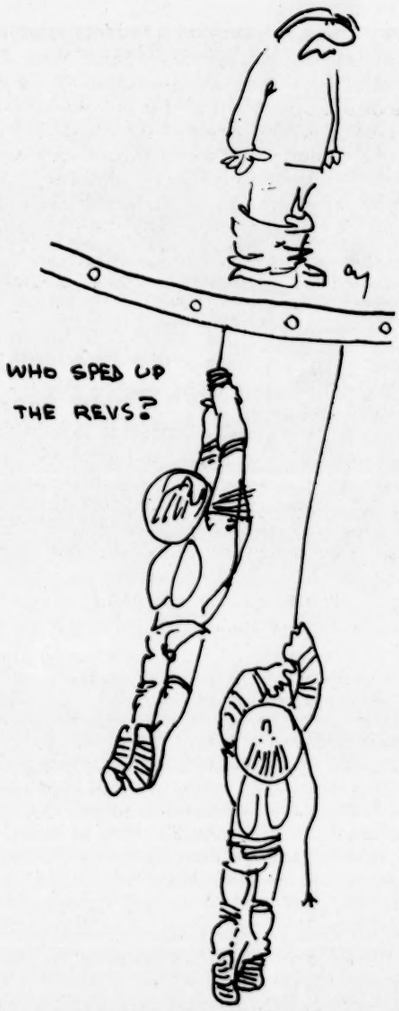
(2) At the top of page 3 is a comment, "But they are, and must and will be, like submarines. . ." I presume this means the colony internal design. Who sez? Sez you! Even a submarine (viz, the Beatles' Yellow Submarine) need not be like a submarine. It is a matter of architectural design and of interior layout.[6a] The prospective population densities are expected to be[7] similar to those of San Francisco or of other cities, and the pleasure of living will be enhanced by an absence of autos, highways, and urban noise.

6a. By this I mean that these colonies, whether small or large, spartan or luxurious, will look like what they are — artificial environments, large containers floating in space (perhaps with some windows). They might even be as luxurious as the lobbies of Las Vegas hotels, or the insides of luxury ocean liners, which some people like. What they will not look like is the natural environment of the earth's surface. 7. This is sales talk, or an unrealistic hope. If and when such habitats are built, it is almost certain that most of them, like military barracks or troopships, will be crowded. More on this later.

(3) Chemical processing for extraction of metals, oxygen, and glass. Before addressing this critical problem, let us first consider the defining parameters within which a solution must be found.

The difficulties attending this prospect, space ore-processing, must certainly be daunting. To begin, the ores are not rich concentrations of oxides or other simple compounds, such as we find on Earth. Rather, we will deal with typical lunar materials such as anorthosite, plagioclase, ilmenite, forsterite, and the like. These typically involve complex chemical compounds, and concentrations rather lower than we are accustomed to dealing with.

Then, it is entirely true that we have no free availability of air or water, or of cheap carbon for reduction. Recycling of these materials will be essential.[8] The problem of heat



disposal will also be critical.[9] But while we must be aware of these constraints, we also must realize we are operating under conditions which in other respects are more favorable than on Earth.

8. "Re-cycling?" Where are these materials to come from in the first place? 9. Very true. And, as I said in my earlier letter, here we have no experience whatever to guide us. We do not know how to dissipate very large quantities of heat without a cooling medium. Yet this is a problem that must be solved before any construction of colonies can begin.

The chief of these is the economics of materials production. On Earth, for example, it may be required to produce metals at fifty cents a pound. This is about right for steel, and somewhat lower than the cost of aluminum, I believe. But at the colonies, far higher costs are tolerable. The reason is that the metals are not to be produced for sale as raw ingots, but rather are to be used in space for construction of power satellites, and of similar projects producing a very high economic return.[10]

For example, let us suppose that the prime chemical plant costs $60 billion over a twenty-year period, for its design, development, construction, establishment in space, and operation. In this time it produces one million tons of raw metals and two million tons of byproduct oxygen, most of which is used for rocket propellant. The net cost of these products then is $10 per pound, which by terrestrial standards is uneconomic. But the alternative, in space, is to ferry them up by rocket transport, at $100 a pound or higher.[11] (This is the transport cost to L5.) Moreover, the power satellites built at the colony may by then be generating a revenue of $30 billion a year, thus amortizing the debt — and then some.

10. & 11. Here I must refer you to my point No. 39. For reasons I point out, there will not be a very high economic return, if any at all. And the costs against which these costs should be compared are not the costs of sending this material into space from the earth's surface, but the cost

of obtaining a comparable amount of energy from the sun (or wind, tides, etc.) on the surface of the earth.

In addition to being aware of these economics, we should also be aware of the opportunities for integration of the chemical processing with the rest of the colony. The colony's thermal design may be so arranged that waste heat from the ore-processing would be used for internal space heating.[12] Then, the entire surface of the colony would function as a radiator.

12. It is almost certain that the waste heat from the metals refining process will be far greater than the internal space heating requirements of the colony.

Having said this, let us consider specifics. What sort of methods for ore-processing appear of interest? We have considered methods for the extraction and refining of aluminum, of titanium, and of glass; of these, the smelting of aluminum is indicative of the processes. We begin with lunar anorthosite. This is melted and quenched[13] to produce a glassy solid. This substance is treated with sulfuric acid[14] to extract the aluminum in the form of its sulfate. The sulfate is then treated with chlorine[15] and carbon dioxide. The former is electrolyzed, yielding aluminum. The carbon dioxide is put through the Bosch process, to recover the carbon and to produce as a by-product, oxygen.[16] Also, the sulfuric acid is recovered through acid reformation.[17]

13. "Quenched." How? And with what? And how obtained? 14. How obtained? Is sulfur plentiful on the surface of the moon? What will be required to refine it? 15. Again, how obtained? Same questions as above. 16. What are the raw materials requirements of this process?

17. Again, what other materials are needed to carry out this process? My point is that to establish in space a smaller scale counterpart of our materials refining and processing industries on earth, a great many raw materials must be produced — not just aluminum, oxygen, glass, and a few others, but a host of metals, chemicals, etc. These processes are interlocked: to make A, we require B and C; to make B and C, we require E, F, and G — but also a great deal of A. To get the thing going at all would require that we lift out of earth's gravity and into space very large quantities of materials — hardly less than many tens of thousands of tons.

We have considered the individual steps required for ore refining[18] through such processes. The temperatures required are typically of a few hundred degrees Kelvin where caustic chemicals are present, and up to 2000° K for the melting. The chemical technologies involve such long-established methods as treatment with sulfuric acid or with chlorine; indeed, the carbochlorination and electrolysis steps represent a process patented by Alcoa, for use with low-grade ores.[19] Certainly, we do not anticipate a need for any technologies as advanced as the hexafluoride methods which were developed so successfully for uranium isotopic separation, over thirty years ago.

18. Aluminum only. But an industrial base cannot be made from aluminum alone. The key metal is steel. What about steel refining? And what about chromium, molybdenum, tungsten, vanadium, and other metals needed to produce modern steel alloys? And what about tin, lead, copper? Do these exist generally on the moon's surface, and in what sort of alloys, and in what concentrations? And what kind of refining processes will we need to extract them? In taking the example of aluminum, Heppenheimer has picked the easiest case. What about the hard ones? 19. Yes; but these processes are not carried out in a totally enclosed space surrounded by a vacuum. We do not know how to do this.

We have estimated the overall systems requirements for a production capacity of 150 tons per day of aluminum.[20] We find the plant mass required is 7600 tons. The chemical inventory is 650 tons; the processing equipment is 3500 tons. Powerplant mass is 2800 tons. We estimate the required energy as 76 megawatts for process heating, 115 megawatts as electricity. Of the latter, 70 is for electrolysis and 40 for carbon reforming (Bosch process). Some 600 tons is required for the space radiators, with area of some 100,000 square meters.[21] The associated radiator temperature is 600° K or less, which is quite conservative for proposed space radiators.

20. It is not clear whether Heppenheimer thinks this is all the capacity that would be needed, or whether he has just picked this figure out of the air for purposes of illustration. If the former, the figure is absurdly small, as I will later show. And in any case, what this plant would be producing would be raw aluminum. Later, Heppenheimer talks of making much of this into cable. What would be the materials and power requirements for the factories to do that? Or to make the other forms of finished aluminum that would have to be used? 21. This is very speculative. In any case, there would almost certainly have to be some kind of closed, circulating coolant (like the water-system in an auto engine) to carry heat from very high temperature areas to the radiators.

I feel that this work represents a useful preliminary effort to assess the requirements for ore processing. This difficult problem certainly represents one of the critical areas in which a modest amount of research is expected to pay off in greatly enhanced understanding of the issues involved.[22] However, this work certainly has given an indication of the types of issues with which we will be concerned. It is far, far too early to say we have achieved anything like full understanding of these issues. But we are quite prepared to propose and to defend answers to the types of questions asked in the letter.

22. This is very modest and tentative language, very far removed from the language of O'Neill in his articles. He does not talk about understanding issues involved. He says we know how to do this, right now. I will return to this point again.

(4) Lunar mass-driver. I am particularly pleased to have the opportunity to address this issue, since it is one on which I have spent a great deal of effort. So far from this mass-driver being beyond the state of the art, I would be quite delighted to point out how it may be built with existing lasers, tracking systems, alignment controls, cryogenics, and the like.

The linear synchronous motor, proposed for the acceleration drive, is an application of classical electric engineering. It certainly is much less complex than such commonplace devices as computers, particle accelerators, or similar electronic systems. It has been extensively studied for its possible application to high-speed ground transport.[23] It is irrelevant to state that such linear motors as we require have not yet been built, for the development of such motors appears to be a straightforward exercise in systems engineering.[24]

23. One would think from these words that linear electric motors were in common use, their problems well understood, their bugs ironed out, as is generally true of computers and Heppenheimer's other examples. Such is not the case. The linear electric motor is in a state of early research and development. To my knowledge, it exists, at least as a form of vehicle propulsion, only on a few miles of test track in a few countries. No practical, operating, installations exist, and none are projected for something like another ten years. We have to ask, if it seems likely to take ten years before we have a linear electric reailroad on the surface of the earth, operating at perhaps 200 mph, with acceleration and decelerating forces of perhaps ½g, how long will it take us to develop and perfect a 4,000 mph railroad, with accelerating forces of 25g's and decelerating of 75g's, on the surface of the moon? I have no doubt that given enough time and money, it could be done someday. But it certainly can't be done, as O'Neill has repeatedly suggested, within the next five or ten years. 24. This is advertising agency talk, not scientific talk. One might say the same of the development from the Wright Brothers' airplane to the 747. Such talk ignores the relevant factors of time and cost.

The accelerating vehicles ("buckets") are envisioned as being built around small, powerful cryogenic magnets such as are well understood by physicists.[25] The velocity measurement systems proposed involved laser doppler from fixed locations, with no delicate hardware carried aboard the buckets:[26] in our estimates of the achievable accuracies, we have used the state-of-the-art performance of existing mode-locked lasers.[27] The problem of track smoothness is largely overcome by arranging for the buckets to be suspended above the track, by means of magnetic levitation; again we here propose to rely on technologies developed for ground transportation.[28]

25. As it happens, they are well understood by me. For any who may not know, cryogenic magnets are magnets that operate at extremely low temperatures, not far above absolute zero. They are kept at these temperatures by liquid nitrogen or helium (perhaps other gases), liquefied by complicated and expensive processes, confined under high pressure, and heavily insulated from the outside environment. Such magnets are expensive, cumbersome, and fragile. They exist now in the protected environment

of laboratories, not along the edges of a railroad track on the moon, where ground surface temperatures may vary as much as three or four hundred degrees. The distance, in time and money, from today's cryogenic magnets to the lunar railroad O'Neill proposes, is comparable to the distance between the radio and airplanes of, say, the 1920's, and the color TV and airplanes of today.

26. I stand corrected on this point. I take it that Heppenheimer is talking about a gadget comparable to that which the lurking highway patrolman measures the velocity of oncoming cars. The difference is that instead of talking about an accuracy of perhaps one percent, we will be talking about an accuracy of something like one-thousandth or ten-thousandth of one percent — again, in an environment of wildly fluctuating temperatures.

27. Where do they exist? What velocities are they measuring? Under what conditions? Does Heppenheimer claim that, using existing equipment we could regulate the speed of an earth's surface vehicle to the above-stated degree of accuracy? Where has it been done? 28. Here again we take promise for performance. I have followed with some interest the developments in this area. The facts are that the companies, mostly German, that are doing research and development on magnetically suspended trains, are running into serious problems, so much so that within the last year the city of Toronto, which had a contract with one of these companies to develop for them a magnetic-suspension system of transportation, has canceled the contract. It is a serious error of fact to speak of these technologies as "developed."

The principal requirement for accurate track alignment arises from the fact that slight misalignments will give rise to vibrations, transmitted to the payload on the bucket, thus preventing release and launch with desired accuracy. The track thus must be aligned to high accuracy immediately prior to release. This is to be done by supporting the track upon screwjack actuators. An alignment reference is provided by lasers; detection of track misalignments is provided by means of track-mounted Fresnel zone plates.[29] The specifications of the alignment system have been taken as those of the existing alignment system of the Stanford Linear Accelerator Center.[30] We have used methods of classical control theory to estimate the associated launch errors and miss distances; we find that following a flight of 40,000 kilometers, the launched payloads should arrive within a circle of 100 meters diameter.[31]

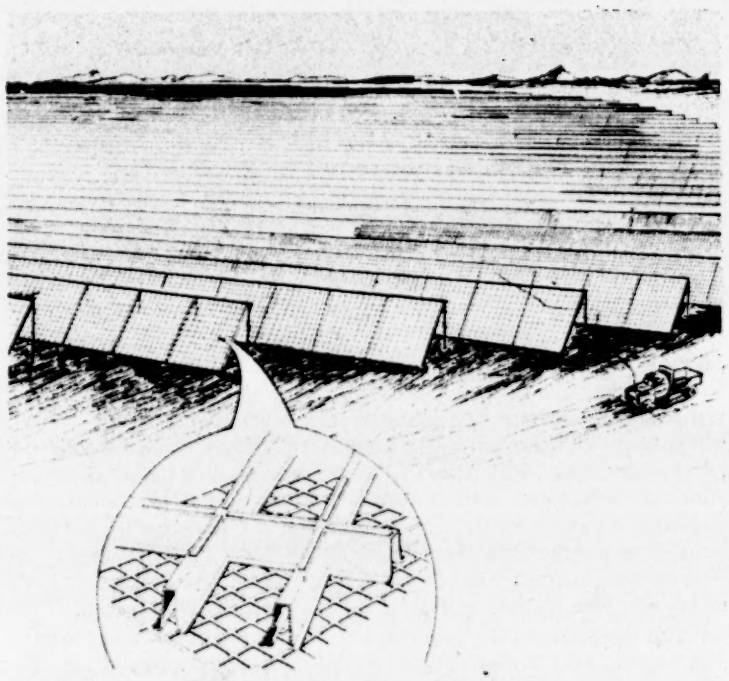
29. Once again, we have the difference between what can be done under closely controlled, optimum laboratory-type conditions, and what would have to be done in a much more difficult, variable, and uncontrolled environment. The Stanford Linear Accelerator is, to my knowledge, underground, carefully shielded from shocks, temperature changes, and other disturbances in the environment. Moreover, this accelerator is, in effect, a railroad only for atomic particles; it could accurately be said to carry no load at all. The proposed materials launcher would be a railroad carrying loaded cars, weighing at least several tons, moving at speeds up to 4,000 mph. To maintain an equivalent degree of alignment and rigidity on such a railroad is not a task already accomplished, but a wholly new task.

30. Included above. 31. This 40,000 kilometer flight will be a spiral path around the moon. Neither O'Neill nor Heppenheimer say how high above the moon's surface will be these loads of lunar ore when they are "caught." To keep them within a circle of 100 meters in diameter will certainly require a very precise control of velocity, greater by a factor of 1,000 (I have read) than the control we have so far achieved over our space rockets.

Thus, the mass-driver appears to be well-understood,[32] in terms of its major features and requirements.

32. What this means is, "We think we know how we might go about trying to build one." O'Neill says we know how to build one right now. We might note here that the maximum speeds of railroad trains in active commercial service, even in those countries (Japan, France) that take railroads seriously and spend money on them, has increased only about 40 - 50 miles per hour in the last fifty years. Some of the problem is with wind resistance, which would not occur on the moon, but much has to do with the difficulty of making a sufficiently level and smooth track — and the requirements of the 4,000 mph moon railroad would be far more stringent in this respect.

(6) Lunar habitat. NASA has conducted systems studies for the definition of habitats housing several hundred men,



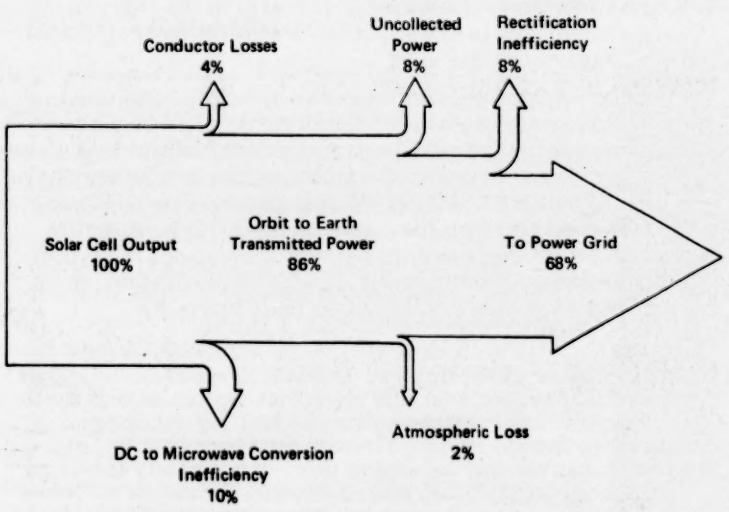
Microwave Receiving Antenna.

and there is a large literature of studies for smaller lunar bases.[33] Indeed, had the U.S. space program continued at the pace of the mid-to-late 1960's (the pace of John F. Kennedy), then by now we might well be on the way to building such habitats.

33. A study is not a habitat. No doubt we had studies for the F-111 or the C-5, and no doubt the studies showed that they would be wonderful airplanes. Events proved otherwise. Building self-sustaining habitats on the moon is to a very large degree a much newer and more uncertain enterprise than designing a new airplane.

(7) Design of large cylinders; structural considerations. The assertion is made that it would be very difficult to devise suitable structures for pressure vessels several kilometers in diameter. This statement misses the point. It is not true[34] that ONACO set the goal of a mile-wide cylinder and then tried to define appropriate structural supports. Instead, ONACO began with specific, rather conservative assumptions[35] as to the technologies to be used. These were principally the bridge-building structural designs similar to those employed in the construction of suspension bridges. ONACO then undertook to solve the problem: with such designs, how large a cylinder could one build? To their great surprise, they found that cylinders a mile or more in diameter, and tens of miles long, would be possible.[36] Thus, ONACO do not envision "massive stiffening beams"; rather, the emphasis is upon tension cables of conventional design. This involves the production in space of large quantities of wire and cable, rather than the fabrication of immense and massive structural members.[37]

34. I did not say it was. 35. That depends on who defines "conservative." 36. The proper comment here is GIGO, a computer maxim standing for "Garbage In, Garbage Out." Whatever O'Neill may have fed into his computers, what has come out is nonsense. The previously mentioned figure of 150 tons of aluminum ore per day shows that O'Neill has enormously underestimated the amount of materials that would be needed to build the kind of cylinders he talks about. It can be shown quite simply that if it takes a certain weight of materials to build a container of a certain size, to hold a certain pressure of gas, if we hold the shape and the pressure constant, the weight of materials needed will vary with the volume — double the volume, double the weight of materials. Or, in other words, the weight of materials increases as the cube of the linear dimensions. If we ask, how much material would we need to build, to use one of O'Neill's favorite shapes, a cylinder 100 feet long and 25 feet in diameter, to hold (with appropriate safety factor) a pressure of one atmosphere, a ton seems an optimistic answer, and two or three tons much more likely. But let us say a ton. Consider now a cylinder 2 miles in diameter and 8 miles long, not by any means the largest that O'Neill has proposed. Its linear dimensions are 400 times greater. This means, not taking into account the weight of its associated machinery, or soil, air, and water, or stabilizing ballast, but considering only the shell itself, we would need



Summary of Microwave System Losses.

400[3], or 64 million tons of material, to build it. For that little 150 ton/day plant, that would be something over 1,000 years worth of output.

37. So what. What is critical is the total weight of material. I realize now, too, that Heppenheimer, when estimating the weight of his 150 ton/day aluminum plant, did not take into account the weight of the dwellings required for the people working there, or the weight of the system required to raise the food that these people would eat, or the weight of the systems required to recycle their wastes. And this leads me to wonder, for every worker engaged in primary industrial production, whether of aluminum, steel, sulfuric acid, chlorine, hydrogen, oxygen, etc., etc., how many more would be needed to maintain and repair all these factories, dwellings, vehicles, "farms," etc., or to supply all the needs of the people? How many people would we need in space to operate a factory that required 100 workers?

(8) Power beams from the power satellites and safety assurance. The power beam is to be formed by means of a phased-array antenna involving microwave generators (Amplitrons) and ferrite-core phaseshifters. These exist and can be mass-produced by the electronics industry.[38] The beam will illuminate a target area at the Earth of some 50 square kilometers. Considerations of physical optics prevent the focussing of the beam into a smaller area.

38. No doubt they exist and can be mass-produced. But they have never been put together and used in this way and for this purpose, and least of all in space. We will have to learn, by trial and error, how to do that.

The associated power densities will approach a kilowatt per square meter at the center of the beam. This is somewhat less than the intensity of sunlight;[39] birds and animals will in no way be fried or cooked. However, they are likely to find the beam uncomfortably warm, thus avoiding it.

39. Here we reach the most extraordinary paragraph of Dr. Heppenheimer's letter. If his words mean what they appear to mean, and it is hard to see how they could mean anything else, we are seriously being asked to consider spending something like 100 billion dollars so that, from a point in distant space, we may beam to 50 sq. kilometers of the earth's surface somewhat less energy than the unaided sun (at least on sunny days) regularly delivers to the same area. This surpasses belief. And it totally destroys the myth of the eventual cost-effectiveness of such a project. If we were getting from space what we could not get anywhere else, there might be some grounds for paying these enormous prices for it. But the relevant comparison must now be against the cost of developing solar and sun-related (wind, etc.) energy on the surface of the earth. At this point the absurdity and wastefulness of this proposed project becomes clear.

Excuse me, John. As you must know, the microwave energy continues to arrive in all weathers and all night. It is far more easily converted to electric current than sunlight — the inefficient (and waste heat producing) part of the conversion having been done in space. The steady supply eliminates the need for storage, which remains the major problem with solar conversion to electricity on the Earth's surface. —SB

The beam will be formed using a pilot signal from the ground to provide a phase reference. This phase reference will serve to control the phase-shifters so as to form a tightly-focussed beam from the outputs of the individual Amplitrons. The pilot signal, in turn, will be run off power obtained at a fixed site (such as the nominal target area center) from the microwave beam itself. If the beam wanders off-target, this pilot signal will lose its power and effectively shut off. Then, lacking a phase control, the phaseshifters will fail to provide a coherent beam. Instead, the individual Amplitrons will radiate into the entire forward hemisphere of the antenna. The beam will spread out, and at any point on Earth the signal intensity will drop by some ten orders of magnitude, to levels such as are used in communications.[40]

40. I stand corrected here; I suppose such a control system could be made to work reliably. But No. 39 makes the question irrelevant; if we are not beaming energy to earth in enormously high concentrations, there is no economic reason or justification for doing it at all.

Thus, it is not the case that we will rely on techniques which can fail and produce disaster. We will not build a power beam transmitter which could swing about wildly, the beam being possibly quite hard to turn off or to control. Instead, we propose that it will be somewhat difficult to form the beam, and that a continuous control will be required merely to keep it properly focussed.

I am amused by the comment, "No doubt we can transmit power through microwave energy on a laboratory scale, but that is not at all the same thing as doing it on an industrial scale. The technology to do that does not exist." I suppose one would have made a similar comment about transmitting human voice or music through microwave energy, in the year 1910.[41] Actually, we are somewhat better off than that. The development of radio was immensely advanced through the invention of the vacuum tube, but we already have all the inventions[42] we need to do the job.

41. It would have been true. I return again to the point made in my earlier letter and many times in this one, that O'Neill and his supporters enormously underestimate the costs, in both time and money, of turning laboratory-scale inventions into industrial-scale technologies — costs certain to be far greater in the unfamiliar, radically different, and highly dangerous environment of space. 42. As above.

(9) Problems of rain and of dynamic balance in large cylinders. The largest cylinders will have atmospheres of radially varying density as well as clouds, so that rain may well be obtained much as it is on Earth.[43] If that is inconvenient, we will use sprinklers and give everyone a constant blue sky.[44] It may seem that a total lack of rain would be unnatural and even frightening. But to residents of southern California or Arizona, it is everyday reality. It all depends what you are accustomed to.

43. The conditions which generally produce rain on the earth's surface — variations in terrain, very large air masses of different temperatures, presence of microscopic dust particles (apparently needed for raindrop formation) etc. will not exist in the proposed space cylinders. By keeping the air at something close to 100% relative humidity, it might be possible to cause a little rain to fall when "night" cooled down the cylinder. But this would not be a pleasant environment to live in. 44. For years scientists have written that the blueness of our "sky" is caused by the diffraction of sunlight passing our upper atmosphere. No comparable conditions will exist in a space cylinder. People looking up will see one of two things: a) other parts of the cylinder on which people are living, or b) windows, through which they will see the sun (if it is being reflected in), perhaps some stars, and otherwise the black of space. In any case it will be clear to all that they are not in an environment similar to earth's surface, but inside a large cylinder (or sphere, or whatever).

As for dynamic balancing, that is readily accomplished by pumping quantities of water between holding tanks strategically placed.[45] Of course, it may be that the cylinders will be so massive that the mass-shifts will be small indeed. If we think of the rocking of an aircraft carrier as the men go about their duties, we may have the idea.[46]

45. As an old submariner, let me say that the balancing of a body in unstable equilibrium is not "readily" accomplished. But ballast tanks, as Heppenheimer suggests, might well do the job, though the mechanisms to do this would be large and complicated. 46. Yes, but if the sun were being reflected into the colony, that sun would be rocking in the "Sky," and it shadows would be moving back and forth on

the ground. Some might find this interesting or pleasant, others not; it would surely be unlike Earth.

(10) L5. L5 is a point of stable equilibrium, and not unstable equilibrium, in the restricted three-body problem. When one considers perturbations due to the Sun, it is found that there exists a stable orbit about L5. If the colony is moved slightly, it will not depart from this orbit, but will instead remain close to it.[47]

47. Perhaps; I will have to have this confirmed by some skeptical astronomers. For the moment, it seems that if L5 is a point where the gravitational fields of earth and moon cancel each other out, any movement toward either earth or moon would lead to further movement in that direction, there being no correcting or opposing force. The effect of these forces might be very slight, so that we could say of a 64 million ton cylinder that it would take many thousands or tens of thousands of years before it finally reached the earth. Still, it would be rather hard for those on earth when it did get there.

(11) The last page or so of the paper. These points are largely theological,[48] reflecting bias or intuitive dislike, rather than any semblance of reasoned assessment. It may make the writer feel good to turn up his nose and say, Ugh, I would never want to live there! But this is a poor basis for policy.[49] Certainly, one should not seek to deny others the possibility of what to them may be an important and exciting new type of life, merely because one would not himself choose that life. In this country, we provide for some people to live aboard aircraft carriers, others at Army bases, and still others along the Alaska pipeline, not from esthetic judgments as to whether we ourselves might like such a life, but from considerations of national needs.[50] It can scarcely be denied that large numbers of people will freely volunteer to live in space, even under austere conditions, when this becomes possible.[51] If it is in the national interest that they do so, then esthetic judgments lose much of their force.[52]

48. Again, "theological." My objections to this project are variously ethical, moral, philosophical, political, and economic. (I might add that, according to Gerard Piel, publisher of Scientific American, many scientists themselves oppose this project on moral grounds). To call such objections "theological" is imprecise, and has in it more than a whiff of Dr. Strangelove, or hard-nosed talk about "megadeaths" or "credible first strike capability" or "acceptable risks." And this may be the point to note that in all of O'Neill's and Heppenheimer's talk about space colonies there is no mention of risks. The risks would in fact be enormous. We have already lost three lives in space, and almost three more; the Russians have lost at least three. This is a death rate of something over 6%. But our ventures into space have been very modest, and surrounded by the most elaborate and expensive precautions. It seems altogether reasonable to assume that if we begin complicated mining and industrial operations on the moon and in space, our casualty rate will be even higher, perhaps much higher.

49. Not at all. "Do not do unto others as you would not have them do unto you" is a very good basis for policy, which would have spared us one major and recent national disaster.
50. Here the iron hand begins to slip a bit out of the velvet glove. So we "provide," do we, for people to live on aircraft carriers, army bases, and in other unpleasant and dangerous places. How do we do that? How in fact do we fill the ranks of the Armed Forces? To a large degree, poverty, unemployment, and boredom do the job; when that is not enough, we conscript what we need, without worrying much about "esthetic judgments." The model of an aircraft carrier is not a bad one, to give us an idea of what space colonies will be like. A few people in them will live like Admirals; most will live like enlisted men. The space colony, as O'Neill himself has suggested in a recent (Jan. 18, 1976) article in the New York Times Magazine, will be an ultimate company town, and history can tell us a good deal about company towns — particularly those on which the workers were not free to leave. If "national needs" (i.e. the interests of powerful pressure groups) dictate, we will find plenty of poor people to draft for the menial and dangerous work of colonizing space.

51. I do deny it — unless, of course, they have been told terrible lies about what life and work in space is really like. I expect that this will happen, and in fact is happening, and it is one of my ethical and moral reasons for opposing this project. 52. Oh, indeed they do!

To sum up: We are not claiming that we have found the solution to the energy crisis, or that we have discovered the future human destiny. We are not claiming the right to unlimited funding,[53] or for space colonization to be declared a major national priority.[54]

We cannot responsibly propose that it shall be national policy to undertake space colonization, at a cost of $100 billion.[55] But we are quite prepared to propose that it should be national policy to support the study of space colonization, at a cost of some $1 million.[56] Our proposals are in many ways new, and to some they may be disturbing. But if these further studies confirm present indications as to the feasibility and economic merit of space colonization, then on that basis we may lay this as an issue upon the national agenda.

53 - 55. This is disingenuous. O'Neill, in his articles in the mass media, has said over and over that we can have a space colony operating in fifteen years for 100 billion dollars, and that we should do so. There is nothing tentative or modest about his way of saying this; he is actively lobbying for such a project. Thus, from his article in the N.Y. Times Magazine of Sunday, Jan. 18, 1976, we have: . . . *it appears on the basis of technology being developed for the space shuttle that construction of a high-orbital facility could begin within 7 to 10 years and that it could be completed in 15 to 25 years. . . . The levels of technology required to do all of this have already been achieved.* (underscore mine) . . . *If the concept is realized as soon as is technically possible, something like the following "letter from a space colonist" might be written as early as the 1990's.* (There follows a fictional "letter" which is pure sales promotion, speaking as it does only of delights, saying nothing of difficulties, let alone dangers).

56. A case might be made for spending $1 million for such a study, as long as people representing my point of view — call it "pessimistic theology" if you like — are a part of the study. But we need adversary proceedings here. We need, not just people who say, "How can we figure out how to do this?", but people saying, "This is not worth doing even if we could do it." The almost certain danger is that the million dollar study will lead to another, and another; to a five-million dollar study, then a ten, and so on. Once this bandwagon, this permanent WPA for the Aerospace industry, gets rolling, it will be very difficult to stop it, and the further it rolls, the more difficult, as more and more people have a vested interest in keeping it going.

Let me close by referring once again to my statement that Earth's problems must be solved on Earth. This is not a statement of theology, or even philosophy, but a matter of hard politics and economics. To colonize space to the extent that O'Neill has proposed, to a point where it would make a difference to our population problem, will take, in all probability, fifty to a hundred years or more. These must be years of peace and relative economic stability and prosperity. It would take nothing larger than a minor war or major depression to put a stop to the project, and a major war would of course stop it indefinitely. Beyond that, it is hard to imagine a time in the next fifty or more years when a given amount of money, spent on dealing with Earth's problems, on Earth, would not bring vastly greater benefits than a similar amount spent in space. Thus it would have taken, and would now take, probably less than a billion dollars of research and development in the direct conversion of solar energy to electricity to make that form of power economically competitive over most parts of the world. We have the needed collectors, and need only find a way to mass produce them. In the same way, less than a billion dollars worth of research and development in wind power would probably be enough to make New England, and other comparably windy sections of the world, self-sufficient in energy. And it would take much less than a billion dollars worth of research and development of the kind the New Alchemists are doing at Woods Hole to give to large numbers of the world's poor the means, with very little capital and materials ready to hand, to double or triple their food production. Had we done such research earlier, we would now be energy self-sufficient, instead of at the mercy of the oil-producing countries; we would be prospering, instead of being in a deep and probably lasting depression; and we would be in a position, as we are not now, to make a direct, immediate, and important contribution toward dealing with the problems of the world's poor. All this we can still do, and in a short space of time, if we choose. To choose instead to spend billions of dollars in the way that O'Neill, Heppenheimer, and many others suggest, seems to me in the highest degree impractical, wasteful, and immoral. Someday, in a world where mankind has learned how to put a stop to war and to feed all the world's people, to try to colonize space might be a practicable, fitting, and even worthy enterprise. But not now.

Behind the question

Been pondering the "fatal flaw" of this space colonies routine. You say, "so far no one has successfully challenged the scale, the engineering, the budget or the schedule of the scheme . . . you are invited to find the fatal flaw or to participate in the design and speculation."

Implication: that the "fatal flaw" is to be found in the scale, engineering, budget or schedule. There may well be flaws in those areas . . . in fact I'd bet that if the project continues and receives government funds problems will develop in all of those areas as a direct result of the overriding, underriding all-pervasive flaw in the whole enterprise — a flaw in the nature of participation in the project.

You invite us to "participate in design and speculation," but I didn't notice you inviting us to "put our money where our mouth is." Yours isn't an invitation to participate, but an invitation to rule, to exercise our agency (see **Earthwalk** by Slater) or our Kilroy Syndrome (Hazel Henderson CQ Fall '75). I'm sure that many of your (especially young male) readers will find this invitation tempting. Perhaps this is well and good. Perhaps if those people who think we can solve our earthly problems by trying to get outside our own skins should leave, all the better for the rest of us who know that you don't solve problems by running away from them.

But just because I would like to say "good riddance," don't take this as an endorsement. Far from it. O'Neill, if you can collect all the money you need from private sources who can prove that they didn't rip the bucks off someone else and if you can put the works together without despoiling the environment, then I for one say good bye and good luck, it will be interesting to watch this grand folly. But, don't tell me it's in my best interest and don't take my taxdollars. People cannot be manipulated for their own good.

We should know by now that spending big government money on projects that claim to save us — e.g., nuclear power plants, public schools, modern medicine — is just unworkable. Even the most noble ends become perverted. (Would be colonists should read Illich — **Tools for Conviviality** and **Deschooling Society**). And those "impacted" by the "spin off effects" don't realize it until decisions have been made and dollars invested, good intentions and public participation aside.

For many years the types who read CQ have been saying that new inventions/chemicals/technologies should be proven good and safe before we are forced to consume them as guinea pigs. It's easy to say that about products that threaten to spoil what we hold dear such as clean air, water and a quality environment. But now there is this enormous project that promises to add to our environmental opportunity, a project that appeals to young planners, architects, designers. . . the environmental profit makers if you will (invest a little of our earthly environmental "capital" to expand our environmental wealth). Somehow this space colony thing pits counterculture values against each other. . . . BAD — big government/big business run, escapist. . . . GOOD — environmentally pleasing, mind altering, challenging?. . . and forces either a choice or integration.

Stewart, when I read that you seemed to be supporting the idea of space colonies, I thought that maybe it was a hoax, sort of a test to see if your readers were thinking or absorbing. Then I thought . . . no, it's a challenge to force us to integrate — nice idea. While grappling with this challenge I have been reading, not by coincidence, Slater's **Earthwalk** — a book that describes in detail the flaws in the type of thinking and being that produce space colonies and similar programs. Reading **Earthwalk** it has come to me that maybe I'm giving you too much credit, perhaps you don't really have your finger on what's happening on the "evolutionary front lines."

The apocalypse is a revelation, a rebirth. And just as many beginnings, it also signifies an ending or a recycling. By and large what we are letting go in this rebirth is male domination, male agency. Not so much letting go really as finding the proper balance. We're at that point in giving birth to the new age that a psychologist might call the "impasse." The sixties was the affair, the planting of seeds; seminal.

Then things quieted down. Brewed. Growing going on inside. Gestation. Just recently, the birth pains started. Between pains, things seem normal. And we've never done this before, so the pains seem purposeless and we wonder what we're doing here. Frustration and despair.

Apocalypse Juggernaut, goodbye? You should say apocalypse unnoticed? unfelt? anesthetized? unenjoyed? Don't imply that it's goodbye to the apocalypse. . . space colonies don't threaten the birth process as much as they threaten our digging it — our juggernaut.

Space colonies are a sedative/anesthetic. We're afraid of what is happening to us, so right now escapist fantasy is attractive.

In our culture, men aren't as experienced at birthing as they are at making; not as experienced at nurturing as they are at construction. So, now, this organic impasse/frustration gives rise to printed cries of do something, build something, make something. . . even from those not usually inclined to such excesses.

If we are indeed giving birth to the new age, Slater (**Earthwalk**) is one of many caring midwives. Turn away from your erector sets and listen to the last paragraph of **Earthwalk**:

> To reclaim ourselves and our environment we need to drain energy from the narcissistic tumor that possesses us; to listen, sense, and be here; to retrieve what we have cast off, to repossess what we have projected onto others, to make whole what we have truncated; to move together in a reciprocal dance of integrity and grace. We keep searching for the stargate, but it is not hidden. Hovering delicately in the spaces between things, it has been there all the time. . . .

Kim Allsup
Seekonk, Massachusetts

ERIK ECKHOLM

Planetary analyst at World Watch Institute, author of **Losing Ground** *(reviewed on p. 81).*

Justify it as a worthy extension of the imagination's playing field, as an interesting experiment for the mere price of a puny portion of a gross and misshapen national product, or even as bread and circuses. But not as a solution to the demographic, environmental, nutritional, and other sundry attributes of the earthly predicament. Anyone who knows the simple arithmetic of exponential population growth knows the irrelevance of unearthly migration to the reversal of our current downward spiral. □

Margalef, civilization & space

This letter was begun in response to Sagan's Conjecture, but is also a reply to How the Apocalypse Looks from Here. It eventually gets around to the space colonies. . . .

Margalef observes (in Summer '75 CQ "Perspectives in Ecological Theory") that a system's information-gathering is asymptotic. That is it proceeds until the system reaches a homeostatic steady-state relationship with its environment, at which point the door is shut on any further incoming information. The system has thus grown from a relatively simple unpredictable youth which required a high energy flow to maintain its identity to a relatively complex, predictable maturity requiring a lesser flow of energy. . . .

T.S. Eliot said "mankind cannot bear very much reality." Organisms, civilizations, ecosystems, personalities, machines, the universe — all evolve up to this point at which they come to terms with their environment — as the environment exists at that moment. They are relatively well adapted at that moment to all the conditions for which they have been selected, and "well adapted" implies their efficiency in terms of energy use. Here the process ends. Radical environmental changes find these mature systems immobilized, no longer able to adapt, locked into their own hard-earned stability, doomed. This leads to succession and thus to further evolution. So the answer to your question, "what limit?" may be central to the whole evolutionary-entropic duality of the universe, to say nothing of the up-coming apocalypse. It might be approximated something like this: The value of the inverse ratio of energy-flow to order-increase in a system varies asymptotically as the maturity of the system. . . .

What impressed me most about Margalef was the way his discoveries in ecological patterning dovetail with the large-scale patterns of history — the rise and fall of civilizations. Oswald Spengler (**The Decline of the West**) used the terms Culture and Civilization as periods of "organic succession," Civilization being the destiny of a Culture. "Civilizations are the most external and artificial states of which a species of developed humanity is capable. They are a conclusion, the thing-become succeeding the thing-becoming. . ." This makes a beautiful parallel with Margalef's ecological maturing process. High-energy activities of low-predictability characterize "spring-time cultures" — such as Rome's wars with Carthage or early Christendom's conflict with Islam, both intense life-or-death struggles carried out by true-believers. This contrasts with the low-energy flow and high (if short-term) predictability of such things as Diocletian's anti-inflation price-fixing edict and President Ford's Project Independence. In these activities concern for economic security has replaced religious zeal. In Spengler's scheme the transition of a Culture to a Civilization marks that moment when the system uses its accumulated information to block any further assimilation of information. It's a fixing processing — the attainment of maturity, stability, homeostasis: The *Pax Romana* and the United Nations. From this point on quantity is more important than quality; as E.F. Schumacher points out ("The Difference Between Unity and Uniformity," Fall '75 CQ), quantity even becomes indistinguishable from quality. Spengler: "Pure Civilization, as a historical process, consists in a progressive exhaustion of forms that have become inorganic or dead." The system is now ripe for succession.

Within the crucible of these finished forms — like the spy in the family, the rat among the dinosaurs — there grows a new and vital force, juvenile and unpredictable, a religion which becomes what Toynbee calls the "Universal Church" of the successors. This internal growth, parasitic and rebellious (like us), is as I see it a reaction to the reign of Quantity. It is Quality coming home to Ithaca after a long exile, and as such is a rejuvenating force resulting in a decrease in order within the system as a whole. As a unit of historical study a civilization is by definition a monoculture, and can therefore be compared to an exploited ecosystem in which pests, Margalef says, "increase rapidly in numbers, disperse easily, and their populations are subjected to strong fluctuations and can be reconstructed after heavy losses. . . If exploitation and culture are discontinued, succession starts the reconstruction of more mature ecosystems." For "ecosystems" read "civilizations": "Changes that impose a regression of ecosystems to a less mature stage, or the opening of new spaces to colonization, create new opportunities for the development of new species." And again: ". . . the energy made available by the disturbance is used to make evolutionary advances." All this is in agreement with the various aspects of Toynbee's theory of "challenge and response." (**A Study of History**, 1957.)

But there are problems when we come to the present apocalypse, because there are vast differences between the fall of our Western Civilization and that of any of its predecessors. On the one hand we do indeed seem to have reached that stage at which we have exhausted our creative potential. This is obvious in our political impotence and stagnation, and even in our arts and science we are mostly concerned with the rearranging of old forms rather than the discovery of new ones: collage replaces painting. These aspects are characteristic of steady-state maturity. On the other hand, as everybody knows, we are a fast-changing, turbulent, knowledge-seeking, unpredictable, monocultural, energy-consuming, stress-wracked, future-shocked civilization, and therefore in a state of rapid-growth juvenility.

This gets very hairy of course, but on a fundamental level the two aspects might be resolved by viewing them as the superimposition of two different media of cultural evolution. In the first instance we are seeing a typical civilization in its last days. Cultures are born of the earth and programmed in their formative centuries for certain accomplishments to be fulfilled in their springtimes; if they develop into civilizations these accomplishments are then proliferated and disseminated. A civilization cannot — or at least makes every effort not to — produce or discover anything outside its program. This is Spengler translated into cybernetics. This is typically a cyclic movement in which the spent civilization returns in the end to the earth from which it sprang in a form which Spengler calls the *fellaheen*. This has happened over and over again — twenty times by Toynbee's count — beginning with the first Egyptian civilization some 6000 years ago, and our own civilization is one more repetition of this kind of cycle. So it is possible to view civilizations as waves upon a surface of water, interacting with one another in complicated ways.

In the second instance we have a wave of much longer phase to contend with. This is the great tide of technological advance which began its gradual rise in the early Paleolithic and reared up like a tsunami in the Nineteenth Century. This is part of Margalef's cultural channel of information, which rose out of the genetic channel, which rose out of the ecological channel back in the days of the primordial broth. Seen in this way the cycles of the civilizations appear as wavelets on the bosom of this great ground swell of evolution. This technological tsunami is every bit as great a force for humankind's success or failure as Bucky says it is. The Western Civilization has been the latest and greatest of its beneficiaries. It has created the population explosion but at the same time made possible the "Global Village": we have used it to colonize the entire planet. We have done this so thoroughly that it is probable that the fate of the human species depends on the success or failure of Western technology. If O'Neill's space colonies should become a reality, all of Fuller's intoxicating optimism will have been justified and, even though our civilization will fall like the others, the continuity of cultural evolution will not have been broken. Otherwise, the wave will crest and break. This is the big one we've all been talking about.

The tsunami has a life of its own. It has already entered shallow water and time is running out. We have here a dichotomy of forces. The "super-industrial age," as Toffler calls our tsunami, is a dynamic, rejuvenating force: it's a ravenous energy-eater, thriving on rapid growth and change. But at the heart of the Western Civilization lies an opposite force, struggling to maintain homeostasis, taking refuge in nostalgia and shelter against stimulus of any kind. The turbulence created by the interaction of these two forces rejuvenates industrial society and accompanies a progressive loss of order. I'm as excited as you are about the space colonies, but I'm afraid this is what O'Neill is up against: on the one hand a senile and unimaginative political system still trying to run things according to the rules of the old industrial age, and on the other a technology run amuck,

inexorably bent on wasting energy, producing ecologically disastrous trivia and exhausting its dwindling resouces as quickly as possible. There is definitely a time-slot outside of which O'Neill's plan is not possible.

But let me end by going way out to the edges of the map, beyond the sound and fury of our collapsing world. I was fascinated by Margalef's likening of pre-genetic organisms at the dawn of life to mini-ecosystems, each unique and temporarily self-sustaining through feedback loops — and for some reason I flashed on the Burning Bush. This is Maya: "The introduction of the relatively rigid mechanism of genetic transmission, a successful tool of life, led to the separation of species inside the broth." The paradox of this first biological differentiation is that it resulted not in greater complexity but in a simplification of the broth, rejuvenating it and thus making more energy available, opening up limitless opportunities for further evolution. This was the first and most important case of ecological succession on the planet Earth — the birth of copying. Inventions which furthered the transmission of cultural information, like the printing press, are comparable in evolutionary importance. It may be that in this trend toward more efficient information transmission and storage, in ways that are hidden from us, lies Universe's counterstroke against entropy. Redundancy is memory-loss insurance. We absorb information but the information (in net value) is not diminished. Thus the symbol of God as a Burning Bush which is not consumed may be the perfect symbol for Universe.

The coupling of Margalef's insights into the beginnings of life with the Gaia hypothesis of Margulis and Lovelock and Margulis' theory of the symbiotic origin of higher life forms (**The Origin of Eukaryotic Cells**) leads straight out through the star gate into the technological destiny intuited by Bucky Fuller, and into the other-paradigm weirdness of Clark's **Childhood's End.** Margalef's differentiation of species in the primal ooze might be the beginning of a process whose fulfillment could be the transformation of Gaia from ecosystem to organism. Perhaps evolution is leading to a separation of intelligence and matter — the kind of thing Koestler hints at in **The Roots of Coincidence** — thus freeing the transmission and decoding of information from the second law of thermodynamics. Does that make sense? . . .

Warren Criswell
Natchitoches, Louisiana

Gaia

Hot Gaia

. . . If O'Neill is talking about a 5000 MW energy producer the energy just doesn't get from space to earth through the 5th dimension, it has to pass through the atmosphere (Gaia-breath, remember?) and while I'm sure you can select a region of the microwave spectrum that's relatively transparent, you can't get one that's perfect (you realize this when you speak of Arizona only getting a tenth of the space-flux) so some of that energy is going to be absorbed in transit. Even if it's only one per cent, that is stil 50 MW per station. Now by spreading out the beam of microwaves you can reduce the heat per volume of atmosphere, but you would likely lose efficiency, not to mention requiring greater area (=$$$) on earth. Liberating this quantity of energy into the atmosphere at small spots would do bad things to the weather, I'm almost certain. . . .

Another objection I see is funding. Do you really think the govt is going to let a funky rabble on their new space colony? It is a politically open ended sort of thing now, but open ends have a way of being closed rather quickly if you're talking abt POWER (polit., energy, $$$ or whatever). . . .

John Beutler
Philadelphia, Pennsylvania

GARY SNYDER

Poet, author of Turtle Island *(Pulitzer Prize, 1975); "Four Changes"*; Riprap, *etc. Hero of Kerouac's* The Dharma Bums.
Also see new poems on p. 86.

Thanks for the invitation to comment on O'Neill's space colony. I'm sure you already suspect that I consider such projects frivolous, in the all-purpose light of Occam's Razor my big question about such notions is 'why bother?' when there are so many things that can and should be done right here on earth. Like Confucius said, "Don't ask me about the life after death, I don't understand enough about life yet." Anyway, I'm hopelessly backwards, I'm stuck in the Pleistocene. That is, seriously, I'm trying to figure out what happened to man at the end of the last ice age, which seems to me to have been a major shaping transition, and so I'm still mucking around in paleo-ethno botany, which is a kind of *zazen.*

Metallurgical paradise

. . . you seemed to me to play down the possibilities for heavy metallurgy out there. Now, this is the basis par excellence for industrial civilization. It uses more energy, water, more of earth's mineral substance, her oxygen, & puts out more heat, than any other branch of human work. (1) All that heat, expanded into the solar wind, would be nothing. (2) If ores could be obtained cheaply out there, they would start out at the top of earth's 4,000 mile well; going to market would cost only potential energy plus friction. (3) Thin, reflectively-coated mylar films, billowed out into big solar sails, could be used to fuse, smelt, refine such ores. (4) Zero-gravity would render massive castings easy to move about and work. (5) Vacuum-purity in metallurgical processing yields the strongest alloys; these would sell at a premium on earth, and if they were produced in sufficient quantity, they would amount to corners in the international market; just as English steel "cornered" the European steel market by the 18th Century — nothing comparable available. (6) Liquids in a vacuum (e.g., molten alloy) tend to form spheres. Therefore, just as shot was formed by free-fall in "shot towers" back in olden times, so could ball bearings be produced in zero-gravity. How about — all the ball bearings needed in a single year? Mucho $$! (7) Also, electromagnetic forces could be used to work the metals in zero-g.

Americans would love to get out there & pull off an economic coup like that!

J. F. Muggs
San Francisco, California

HAZEL HENDERSON

Co-director, Princeton Center for Alternative Futures; advisor, Office of Technology Assessment

As you asked, here are some of my thoughts on Prof. Gerard O'Neill's space colony proposal. I have also discussed them with Alice Tepper Marlin and they reflect her views also.

Firstly, I have little doubt that a model space colony could be initiated and I will accept, for the purpose of this discussion, O'Neill's trust in the availability of technology to accomplish this. How long it and its human inhabitants could function according to plan, and what surprises they would encounter are largely unknowable at this point.

I also have no doubt that the money could be found to fund the program, since NASA is still desperately casting around for new, politically-sexy projects and they have a good deal of clout when they lobby in concert with their prospective corporate contractors. Furthermore, the high-tech community is currently drumming up concern on Capitol Hill about a new and terrifying "Sputnik Gap" which will justify hyping U.S. science and technology so as to "improve our competitive position in the world" against all comers. They implicitly assume that the health of the U.S. scientific enterprise is coterminous with the health of the country, so a new WPA-type project to keep them fully employed will not be hard to sell.

It would be nice to believe that the money for the space colony could be carved out of the military budget, or even out of the Highway Trust Fund, the Corps of Engineers, or half a dozen other well-heeled Washington-based, make-work schemes. But we must assess realistically the political mood of the country that "big government must be trimmed," and "the Federal Budget must be cut" etc. You know as well as I do that it is always social spending that gets axed, while "military gaps" and "space gaps" and the fear thereof are always sure-fire stampeders of legislators and voters alike.

Given this sad reality, O'Neill's certainly innocuous space proposal must inevitably compete with other priorities in our national budget. Therefore, less benignly, it will very likely displace programs advocated by weaker societal interests or those less appealing to the voters' imaginations. I suppose it is hard to dramatize food stamps and all the other dreary, ameliorative and income transfer programs that are made necessary to cope with the human casualties and other consequences of our high-tech, industrialized society.

So there is a temptation I have noticed in O'Neill's statements to try to justify the space colony as a hope for the Third World, to ameliorate the population crisis, to solve the energy "problem" and to provide "immediate jobs of the high-technology kind which economic studies have shown generate wealth throughout the economy." O'Neill can't be naive enough to believe such studies, which are based on per capita averaging, and are discreetly mute about how that wealth generated will be distributed. Such studies are usually based on neoclassical economics, now rapidly being discredited within the discipline itself, since such studies rely on now clearly unrealistic assumptions of the free market, where buyers and sellers are supposed to meet each other with equal power and equal information; where these markets are always cleared at the equilibrium point where supply and demand are equal, at however astronomical a price, and a whole string of other myths which I have examined in my own writings. (Ecologists versus Economists, **Harvard Business Review**, July - Aug, 1973, New Models for a Steady State Economy, **Financial Analysts Journal** May 1973, Limits of Traditional Economics in Making Resource-Allocation Decisions, Transactions of the Fortieth North American Wildlife and Natural Resources Conference, 1975.)

In fact, these justifications, based on neoclassical economics and borrowing pragmatically from John Maynard Keynes, seemed to be the main pitch of the group of "true believers" in O'Neill, styling themselves as the L5 Society, who so fervently buttonholed participants at the recent Club of Rome meeting in Houston, Texas. So it seems that this is to be the latest, most baroque elaboration of Keynesian "trickle-down

. . . energy for the Third World (the wrong end of the lollipop again). . .

industrialism." The poor are always told that one day, when those at the upper end of the income scale really have enough then you can get yours. Meanwhile they are told they must accept inequality in economic distribution so that some of us can continue to accumulate wealth for capital investments so that these lucky few can create jobs for those so "unfortunately" dispossessed. This myth too, is unravelling, in spite of the massive barrage of corporate image advertising about how they must have profits since this is the only way to accumulate capital for investment for jobs. We see all too easily however, that corporations given generous tax credits for capital investment in the hope that they will create jobs, quite frequently use their capital investments to dis-employ people, (as the new automated check-out systems in supermarkets, and electronic funds transfer systems in banks will do) or to export the capital to set up factories in the Third World to exploit cheaper labor, or even to go on acquisition shopping sprees, such as Mobil Oil; while pleading for more profits to plow back into developing new energy, it promptly acquired Montgomery Ward and the Container Corporation instead. So far, only the **Wall Street Journal** has jumped ship on this set of myths. In an August 5th editorial entitled "Growth and Ethics," the **WSJ** finally admitted that the American people would have to choose between economic growth and redistribution! The latest escalation in corporate propaganda on these issues is due to begin soon, when the U.S. Department of Commerce is to launch with our tax dollars a $5 million Advertising Council campaign of "economic education" of the American people.

In his less euphoric moments, O'Neill does more soberly assess such issues of concentration of economic and political power, which will so materially affect his space colony's chances of ameliorating our planet's social ills, and indeed, may cause it to exacerbate them. He states, "If the new option is taken, it would be naive to assume that its benefits will be initially shared equably among all of human kinds. The world does not work that way, and since people do not change, there is no reason that it will work that way in this case." So the moral seems to be, "If you can't beat 'em, join 'em."

I will leave assessments of the biological feasibility of the space colonies to those more qualified: Lynn Margulis, Paul Ehrlich and others. Paul Ehrlich suggests, "A biologist like George Woodwell, who really knows ecosystems inside and out, will have to sit down and explain to O'Neill why his

ideas are complete nonsense." At least, I sense some sweeping dismissals of possible biological constraints in such phrases as "the space community residents could enjoy a per capita usage of energy many times larger even than what is now common in the U.S., but with none of the guilt. . . ." It seems to me that in the U.S. we are already consuming more energy than we can digest, and we have all the pathologies of high-energy industrialism to prove it, from the current epidemic of cancer to hypertension, mental dis-ease, drug addiction, heart ailments and obesity.

Similarly the blithe dismissals of long-term effects in O'Neill's statements: "People can breathe pure oxygen atmospheres perfectly well. The Apollo astronauts were breathing pure oxygen atmospheres for days at a time. I've done it for hours at a time." and "Plants couldn't care less." One wonders at this typical attitude of scientific over-optimism. I have just read a rather shattering paper on "Scientific Optimism and Societal Concern," by Gerald Holton, Professor of Physics at Harvard (**Hastings Report 5**, Dec. 1975). Holton comments on the psychology of scientists as well as their acculturation. The scientific and technological imperative are both powered by the same optimistic dynamism. The prevalent "other-orientation" of scientists leads them to attempt to transcend people-oriented problems and escape to a world filled with order, rationality and neutrality. Problems with a high degree of non-falsifiable and non-verifiable content are avoided in favor of problems submitting to quantification or instrumental manipulation.

In the last analysis, for me at least, the space colonies appear as simply a linear extension of the technological fix, instrumental rationality so beloved of this culture; another case of too much hardware and not enough software. Perhaps O'Neill would enjoy tuning in to some of his fellow physicists who are exploring the physics of consciousness and trying the indescribably more difficult task of writing the observer back into the equation (see for example, Jack Sarfatti and Fred Wolf, **Space-Time and Beyond**, Dutton, 1974). If our destiny is, as I believe, to strive for cosmic consciousness, I cannot see space trips in clunky, materialistic, tin-lizzie spaceships as the means for embracing the cosmos. Surely we will roam the universe with our minds and dream up far less materialist, more elegant means to re-structure and re-pattern ourselves. Surely we can leapfrog the current instrumental materialism and perhaps, even escape the prison of matter entirely. For heaven's sake, what difference does it make which arm of our spiral galaxy we are in? Will journeying across it in a spaceship really change anything? As O'Neill himself says, "people manage to make themselves unhappy in almost any circumstances." When will we stop trying to re-tool the planet and get on with the job of trying to re-tool ourselves? For me, not the High Frontier, but the Human Frontier. My question remains. "Why?"

Space war

I just heard on the ABC network news that the Russians have been "blinding" our spy satellites with high powered laser beams. I took note of this development because of a book I've read recently called **Soviet Conquest From Space** by Peter N. James who is an intelligence expert with our government.

In his book is a highly documented comparison between our military/space programs and the Russians'. The book concludes that the Russians are pulling ahead of us in rocket development, space shuttle and space station deployment as well as militaristic use of laser beams. Mr. James said to watch for Soviet space developments over the next few years and we will see a better space shuttle system than ours which will enable them to embark on an extensive space station network. These could very easily be used to store and deploy nuclear weapons.

I've only touched on the most major points in the book and I mention it not only for its own significance but what it could mean to the future development of O'Neill's space colonies, oneupmanship being what it is between governments.

Douglas Nommisto
Wood Dale, Illinois

ANNE WALDMAN

Poet, author of **Fast Speaking Woman**

Space colonies decidedly fun to speculate & project one's fantasies upon – might be great to start all over again – forget the recognizable tip of Bermuda or the grooviest street in Paris & no cars please – but maybe no way out of earth replication? Wouldn't mind plugging into Renaissance Italy or Hangchow at its height (Sung) or Egypt when they first connected with the stars – 20's in Harlem? – What troubles me is how elitist (who gets to go) the colonies might become. Wise organizers, yes, but what's the cost? Lots of folks never get out of NYC or Calcutta or the barrios of Bogota. I mean the planning might be idealistic & farsighted but who's really in charge these days, huh? Maybe we could get the whole trip going after world socialism (a new brand) at its best sets in.

VINE DELORIA, JR.

Sioux writer, author of **Custer Died for Your Sins**

The human species now faces a primary question of its place among the other life forms and unless it resolves the perennial struggle which it has initiated on the planet among members of its own kind and against other species, the human will be seen by other parts of the universe as a deadly cancer which it must not allow to spread.

Colonizing outer space is not possible until the inner space which connects individuals is discovered and explored. This task cannot be that of a solitary individual or even of groups of highly skilled technicians. Rather it is the general responsibility of the human to reach out from the self-imposed solitude which pervades the various societies of people and grasp the common themes which bind humans to one another. Our understandings of the world must truly shatter and break apart but as they dissolve under our intensity we must assume responsibilities beyond the powers and abilities of any particular individual of our kind to encompass the meaning of universal existence.

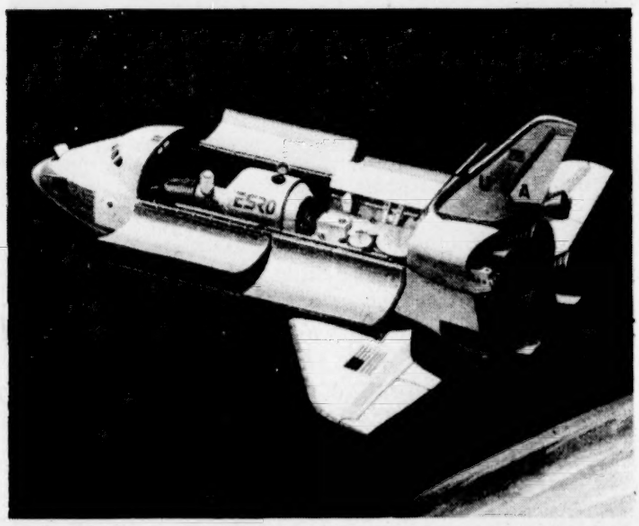
Our technology is more than a clever way to deal with the gross physical barriers in our environment. In a more profound way our technology makes a statement about our beliefs concerning the ultimate nature of reality and our place in it. The arrogance of turning toward space when we have not been able to cope with the immediate problems of our neighborhood is a more fundamental objectification of the inability of ourselves to understand our history, our society, and our ultimate place in the universe than any sin, no matter how original, for it forecloses us from learning from the rest of the universe the conclusion towards which the cosmos is growing. We shall be no more than a footnote in cosmic history unless we open ourselves to the universe and join with it in the exploration of experience.

Brazil's space colony

The space colony idea is about as brilliant as making Brazilia the capitol of Brazil. When we figure out what to do with the allegedly rich interior of Brazil without massive disaster, there will be time enough to think about colonizing outer space.

It seems to me that it is violating the principles of the title of your publication. We (and all other living things) have adapted (coevolved if you will) to the Earth's environment. Success would undoubtedly depend on recreating the conditions of the surface of the earth as closely as possible, which is easier at home than in space. . . .

Albert Himoe
Houston, Texas



The Shuttle in orbit, with Spacelab in its 15 foot x 60 foot payload bay.

GURNEY NORMAN

Author of Divine Right's Trip

O'Neill's space colony idea is fascinating and the conversation it is provoking is important. But the technological processes by which space colonies may be created are the least important aspects of the conversation, and to me as a storyteller with some degree of political awareness, the least interesting. I mean, all it is is tinkertoys. There's no question it can be done. As with the atomic bomb and the space program, all we have to do is give the tinkertoy boys a lot of money and say GO! The important question is, how will the building and operating of space colonies affect human beings, in space and on earth? How will they tend to make people organize themselves? Obviously, in order to create small, intimate cities in space, people on earth will have to become ever more centralized and specialized, and I don't like that. O'Neill seems terribly naive politically when he envisions space colonies sponsored by individual earth-nations. Does he not understand that the colonies will be controlled by politicians, that Russia's colony will be up there to encourage communism and America's colony will be there to spread exploitive capitalism throughout space? Both colonies will be crawling with CIA and KGB, each spying on the other's strip-mine operations on the moon.

I do not mean these cynical observations to indicate that I am unalterably opposed to the establishment of space colonies. If it could be arranged to delay their creation for three human generations, during which time earth people could somehow organize themselves so that all earth people are represented by a single space colony, then I could root for that. I see the main use of space colonies as religious. They should be built, not as industrial enterprise, but in the spirit of the old Cathedrals, like Canterbury. We should take it all very slow and build in all the meaningful earth-stories and myths. Clearly space colonies have more to do with myth than science or industry. I want the connection between the Indian Coyote tales and the Space colonies to be very direct and clean. I want the building of the colonies to encourage folk life and country music and old time religion, not discourage it. I want the colonies to have a lot of winos and neer do wells hanging around the old computer consoles, singing and praying and spitting and telling lies. I want there to be places for Neal Cassady and Nimrod Workman, and Merle Haggard and Jeff Kizer and Ed McClanahan and me and Chloe. There's the real test. "Do I want to go, or not?" In my head I'm against all this space stuff. But in my heart, if they're goin' to build 'em, I want to be on one. I want to get to heaven, by hook or crook. I'd feel a whole lot better about it all, though, if that guy hadn't hit that golf ball on the moon. I sure do dread being locked up in outer space with ten thousand golfers.

Daughter

. . . Whatever I can do (contribute) – may help my beautiful daughter to slip away from this failing civilization here on Earth.

Capt. Jonas Caron
Watertown, Massachusetts

Investment space

. . . there must be a proven private sector market for use of space. EARTH/SPACE is therefore dedicated to developing low-cost methods of using space, which are of value to individuals and commerical industry. It's not enough to say – we can get you there cheap. You also have to have a reason for wanting to get there in the first palce. We're giving space a reason.

Space can be used to increase the control of authority over the individual; or it can be used to free the individual from the strictures of earth. EARTH/SPACE is, quite simply, making space a place to free the individual by expanding his horizons. The real use and colonization of space will take place – not from the well-ordered designs of a few government planners, but from the random designs of tens of thousands of pioneer individuals.

Paul L. Siegler, President
EARTH/SPACE
2319 Sierra
Palo Alto, California 94303

Compiler

. . . With what the world spends on "defense" in one year – 365 days! – we could solve all of our problems without war or massive starvation. I don't say "solve all of our problems" lightly. Utilizing our vast knowledge, we can, and must, build a very nearly perfect society.

I'm now planning to become extremely involved in development of the space colony idea, while I study toward a degree in Aeronautical Engineering at MIT. With the help of the Space Habitat Study Group (Room 23-413, MIT, Cambridge, MA 02139) and the resources of the Boston-Cambridge community, I'd like to compile a "Whole L-5 Catalog" to summarize the idea, list the many problems, questions and dreams, and provide a guide to the resources available for answering these questions. . . .

Jonah L. Garbus
Bronx, New York

Allure

I was a little surprised at your enthusiastic presentation of O'Neill's space colonies in The CQ. The concept seems to me well thought out, rational, very alluring, and quite mad. . . .

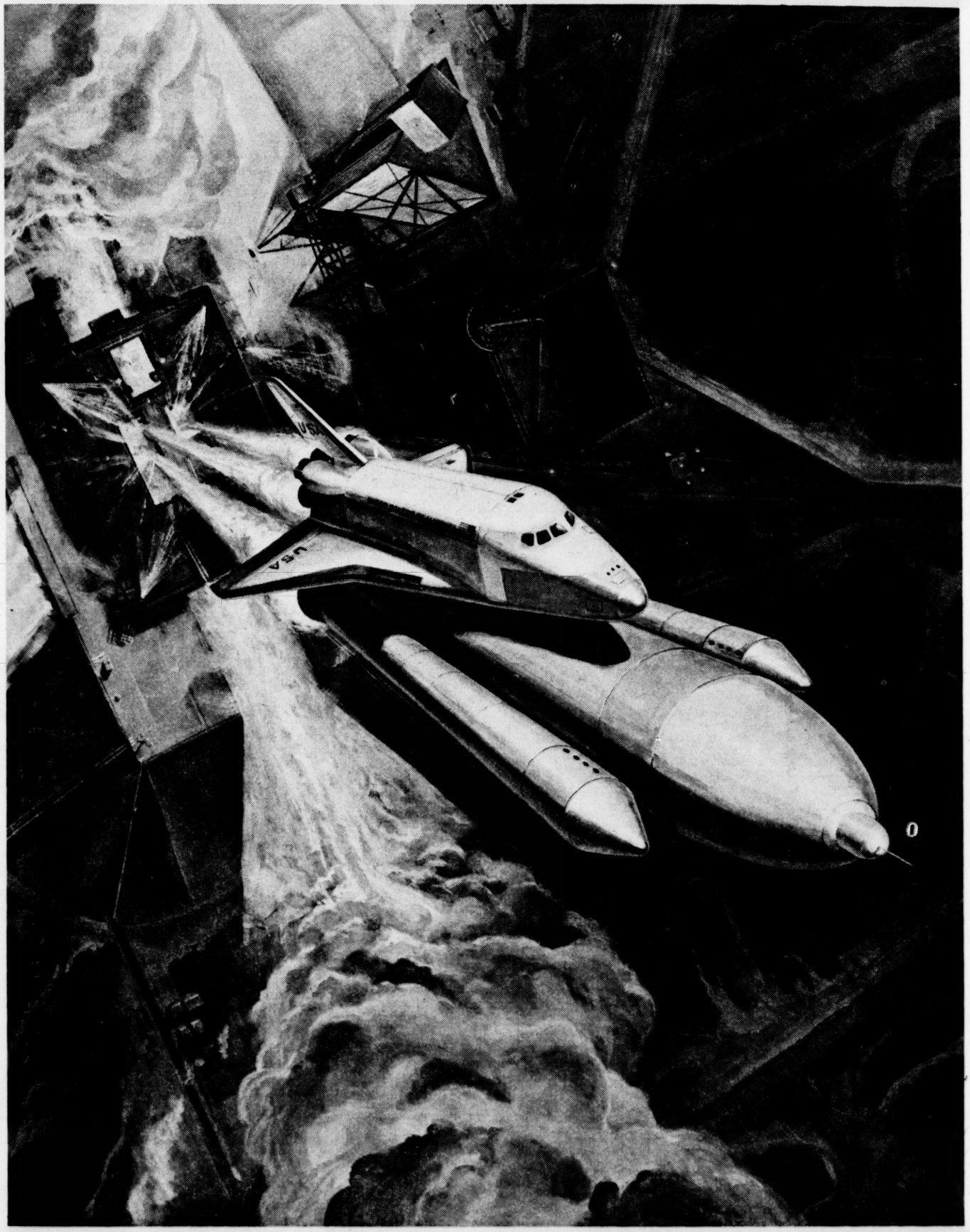
Martin Holladay
Sheffield, Vermont

National Space Institute

Space enthusiasts may want to become members of the National Space Institute. It was set up last July to provide information to the general public and pressure on the government – a space lobby. Actively headed by Wernher von Braun, it's already making waves.

–SB

National Space Institute
Dues, $9/yr for students, $15/yr for adults
Box 23527, L'Enfant Plaza
Washington, D.C. 20024



NASA

Between here and there is the Shuttle, under construction now and due to be flying in the early 1980's. Most of the main experiments toward Space Colonies can be carried out by Shuttle projects, the first of which is the internationally co-operative Spacelab. One of the pilots of the Shuttle may be our friend Rusty Schweickart (pp. 6 and 72 - 79).

The way it works is, the two solid fuel rockets on the sides are jettisoned at 100,000 feet and recovered from the ocean for re-use. The large liquid propellant tank is discarded and not re-used. The airplane-like orbiter delivers its payload and returns to Earth, landing at Kennedy Space Center, the home bus-stop and car-barn of the system.

Brand

Gerard O'Neill at the standing-room-only Senate hearing on January 19.

GERARD O'NEILL

High energy physicist; deviser of Space Colonies; inventor of particle storage rings.

The following is derived (with his help) from Dr. O'Neill's remarks before the Senate Subcommittee on Aerospace Technology and National Needs on Jan. 19, 1976, and his keynote address at the annual national convention of the American Institute of Aeronautics and Astronautics in Washington, D.C. on Jan. 30, 1976. For complete texts, write to Dr. O'Neill at Princeton University.

In the long run it may well be that the people working at the orbital manufacturing facilities may build very comfortable and earthlike habitats. Much of the public interest in this concept may be due to that possibility. In the early days, though, it seems almost certain for economic reasons that the orbital facilities will house a selected, highly-qualified, highly motivated population nearly all of whom will be working, and working hard. They will not be in a utopian paradise or a laboratory for sociological experiments. The orbital facility will be much more like a Texas-tower oil rig, or a construction camp on the Alaska pipeline, or like Virginia City, Nevada, in about the year 1875.

It is natural for most people, and particularly for reporters and art directors, to become preoccupied with two features of orbital manufacturing, both of which are non-essential. One is "Where is it going to go?" and the other is "What is it going to look like?" I think the proper answer to the first question is "in an orbit high enough so that it almost never gets eclipsed," and to the second, "It will be a rotating pressure vessel, containing an atmosphere, with sunshine brought inside with mirrors." Beyond that, any further detail is almost certain to be wrong. For that reason, among others, I think it's unwise to get personally identified with particular designs. I'm for whatever works best, and it's too soon yet to be sure what that will be.

As to resupply, first there's the question of atmosphere. In some of the space habitat designs we're dealing with, the skin thicknesses are 2 to 7 inches of solid aluminum, and we ought to be able to make that gas tight. The problems could come at windows and airlocks. There would be plenty of power available for Roots blowers and compressors, so there would not have to be loss of air each time a lock is opened. Outside window areas it might be best to have a thin secondary membrane with recuperation of any leakage. As a guide, in high-energy physics for the past five years there has been a single-stage ultrahigh vacuum system working with several kilometers of length and thousands of joints, but with a total leakage rate of less than one cubic centimeter per day.

Again, it will be necessary to be careful only if we have to use a nitrogen-rich atmosphere. Oxygen will probably be a waste-product at L5, because the chemical processing plant needed for construction will be separating several hundred tons per day of oxygen.

On the question of food supply, we presently think in terms of fairly conventional but highly intensive agriculture. I doubt that we need to provide cosmic-ray shielding for the growing crops, because the 10 roentgen/year of radiation in free space in a thin pressure vessel would be far below the level where any effects on plants have been detected. It could be that the seed-crops should be grown in shielded areas.

Water for agriculture would be totally recycled, as it is on earth, with the initial stock consisting of 11% hydrogen from the earth, and 89% oxygen from the processing of lunar soils.

What if closed-cycle ecology turns out to be impossible, or takes a very long time to perfect? The fallback position is to bring dehydrated food from the earth, and to add water at L5. A full diet for heavy construction work is about a pound per day, dehydrated, so the budget would be less than a quarter-ton per year per person. On the basis of experience in the heavy construction industry on earth, the productivity of manufactured goods should be from 10 to 30 tons per person-year, so even with the fall-back position the economic leverage of having a man or woman working at L5 would be a factor of 50 to 150.

If satellite power is to have real impact on our energy problems here, it will be necessary to emplace about 15 or 20 stations of 5000-megawatt size in geosynchronous orbit every year. Therefore the lift requirement over a six-year period for establishing a space manufacturing facility would be about 1% as large as for ground-launched satellite power over the same period. Any adverse effects on the atmosphere due to rocket flights would be correspondingly reduced, in the space manufacturing approach, by the same factor of 100.

Recommendations:

I suggest the following as essential components of a balanced program leading toward satellite power:

1) The vigorous continuation and successful operation of the space-shuttle.

2) Continued development of microwave power transmission, leading toward pilot-model demonstrations

here at ground level of phased-array power transmitters as well as planar receivers.

3) Detailed study of the electromagnetic mass-driver, not only as a launching device but for the easier role of high-thrust, high-velocity reaction engines for use outside the atmosphere.

4) Research on earth into long-term physiological effects of oxygen atmospheres and of rotation. Success in these studies could reduce substantially the cost of construction of a habitat for the workforce at an orbital manufacturing facility.

5) Study of continuous-flow chemical processing methods for minerals similar to those found on the moon.

6) Conceptual study of a human-rated version of the LDEF (Long-Duration Exposure Facility): a test laboratory capable of being put into orbit by the shuttle, in which the long-term effects of partial or zero gravity and of various rotation rates could be studied.

7) Studies on earth of high-yield agriculture, under conditions of controlled atmosphere and abundant solar energy, with human intervention (as is customary in agriculture on earth), as necessary, to maintain stability.

8) A balanced set of design studies of earth-to-low-orbit vehicle systems, emphasizing:

a) Minimum development cost,
b) Minimum cost per pound of payload,
c) Minimum adverse effect on the biosphere,

but with less emphasis on massive single payloads. For example, shuttle-derivative freight rockets of moderate size, and single-stage-to-orbit fully-reusable vehicles of moderate size, would receive greater attention if this recommendation were followed.

9) A continued moratorium on the development of nuclear rockets. If our calculations are correct, the availability of liquid oxygen for refueling in high orbit, as a result of the processing of lunar materials, would give to ordinary chemical rockets a higher performance than could be achieved by nuclear stages, and without any risk of serious accidents affecting the environment.

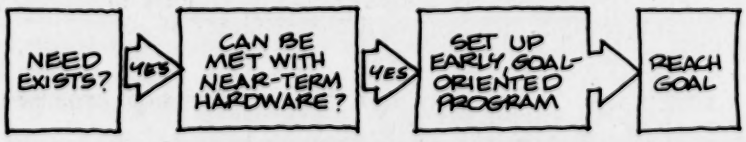
10) Study of space-stations larger than a human-rated LDEF: facilities whose components could be launched by the shuttle or by a shuttle-derived freight rocket, and which when assembled would be suitable as construction and maintenance shops for larger objects. In my opinion the emphasis in these space-station studies should be on productive work, not on physiology, because I see no reason why the purely physiological questions could not be answered earlier and at much lower cost by a human-rated LDEF.

11) Design studies of large power satellites, emphasizing reliability, simplicity, ease of manufacture and conservative technology, with less emphasis on the achievement of minimum weight.

12) Study of an unmanned asteroidal probe, emphasizing the confirmation of carbon, nitrogen and hydrogen resources in the asteroids.

Of these recommendations, it should be noted that (1) and (2) constitute endorsement of programs already under way. (9), though negative in tone, reinforces a decision already made. (8), (10), (11) and (12) are recommendations for taking broader, less restricted viewpoints in conceptual designs already under way. Of the remaining five recommendations, four relate to research of a modest scale which could be carried out wholly at the surface of the earth, at a cost much lower than for operations in space. Only one, (6), is a recommendation for a study leading to a new operation in space. Even that is relatively inexpensive, because it would be entirely within the launch vehicle capacity of the space shuttle.

These are technical and economic considerations. But where if anywhere does this fit into a conceivable space program? The simplistic approach is shown as "direct goal logic."

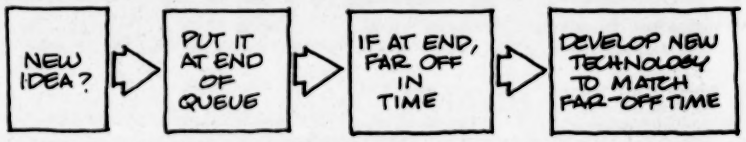


Direct Goal Logic

This is the approach characteristic of wartime or a powerful sense of urgency. Robert Oppenheimer in the 1940's with the first atomic bomb project, Hyman Rickover in the 1950's with the Polaris submarines, James Webb and Tom Paine in the 1960's with Apollo, worked on that logic and they got results on time-scales like 4 to 8 years. My best guess is that the corresponding figure for high-orbital manufacturing is about 15 years.

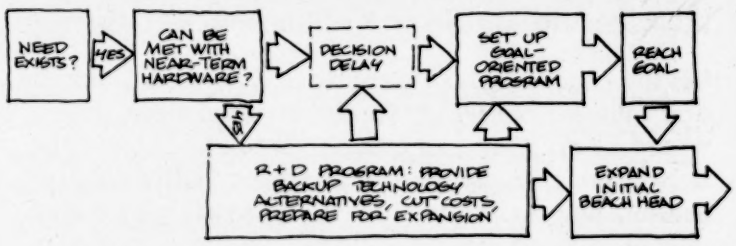
We are certainly not ready as a nation to make that kind of commitment to a goal at this time. We have a deeply-troubled economy, and national wounds are only slowly healing after years of serious division.

In present circumstances we have to accomplish as much as possible without any charter to embark on a sizeable new commitment. In that climate agencies tend to be forced into the "queue logic":



Queue Logic

What can be accomplished under those circumstances? Still a fair amount, by working within the ground rules as they now exist, while preserving at all times an updated plan that would permit shifting to a fast, goal-oriented program if and when that becomes possible. In other words, "Combined Logic":



Combined Logic

There are a number of areas of technical development which fit within the ground rules of the queue logic, and which also make good sense in terms of combined logic. They include a physiological test facility within shuttle launch capability, large-structure assembly in space, new methods for automated metal-forming, a low-orbital space station, study of the mass-driver as a medium-thrust, high-specific-impulse propulsion motor for deep space, development and testing of microwave power transmission, and studies of advanced lift vehicles which could be of value to a number of programs.

There have been two unusual features in the development of the orbital-manufacturing concept: one is public response. It has been strong and mainly positive so far. I think there are four reasons:

1) Immediacy: the possibility of realization not a hundred years from now but within the next decades.

2) Personal participation: The prospect of taking part directly in the opening of an exciting new frontier.

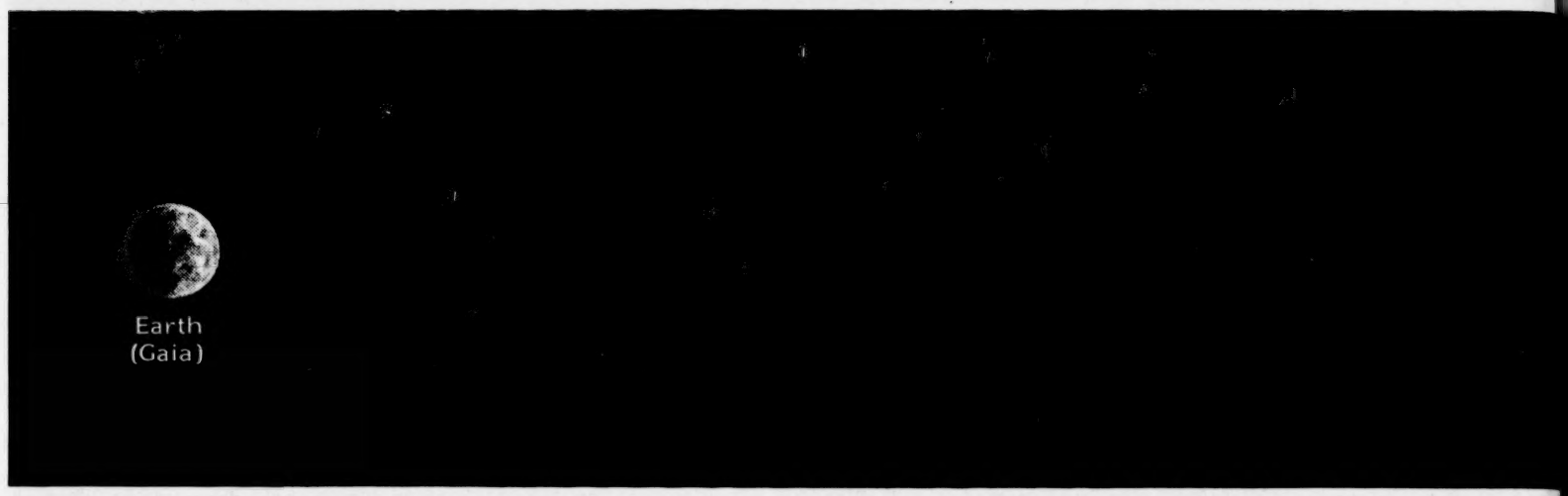
3) The possibility that in space manufacturing there may be a real opportunity to solve the energy problems of the earth within the technology that we already have, and to do so in a non-polluting fashion.

4) The eventual earthlike character of the new territory being opened: that is, the possibility that the new options may involve not a machine-dominated robot-like future, but green grass and trees and flowers.

The second component is the people who have been drawn into this work from outside the traditional industry boundaries. They constitute a resource which is much like the citizen army that is at the nation's service in any threatening war. By the same token, they can be lost by mismanagement or by inaction. Here the time scale is critical.

Discount economics gives us the same message: once it's clear exactly how best to proceed, act fast, because a stretchout in time eats up the profits.

Clearly our task is very big, and specialists in every area can contribute to it. Those of us already working welcome all the help we can get. □



STEWART BRAND

***Editor*, The CoEvolution Quarterly**

The fact of Space Colonies will be as momentous as the atomic bomb. The two statements are equally fundamental. The one says, "We can destroy the Earth." The other says we can leave it, leave home. With that our perspective is suddenly cosmic, our Earth tiny and precious, and our motives properly suspect.

On the other hand, suppose that the Space Colonies don't work, that we do find some fatal flaw. It would be no less of an event. "We cannot leave the Earth" is a thought so foreign to the 20th Century that nothing would be unchanged by it.

Either way it goes the experiment should be made, because not knowing whether we can leave the planet begs all of our important questions. Either knowledge – knowing we can leave or knowing we can't – could make for more responsible habits. Either knowledge is a kind of growing up.

The same applies to the biology. If we can learn to successfully manage large complex ecosystems in the Space Colonies, that sophistication could help reverse our destructive practices on Earth. And if we fail, if our efforts to impersonate evolution in Space repeatedly run amok, then we will have learned something as basic as Darwin about our biosphere – that we cannot manage it, that it manages us, that we are in the care of wisdom beyond our knowing (true anyway).

Is balance really possible where even the gravity is manufactured? It would be nice to know.

The commonest complaint in this issue of **The CQ** is that Space Colonies are merely more of the same – the same old technological whiz-bang and dreary imperialism. I'm arguing that the success of Space Colonies would bring needed whole-system sophistication, their failure would bring needed whole system humility, and only not trying them at all would bring more of the same.

Besides, Space Colonies are distinguished from other high tech mischief such as nuclear energy, the SST, and the Arms Race by a major difference. They take place outside the Earth's atmosphere. They are separate whole systems. The experiment of Space Colonies endangers only the experimenters. When high tech goes wrong on Earth it is the innocent who get the consequences, down wind, downstream, and down the years.

What Space Colonists use from Space – energy, materials, and location – is taken from no one else. They are out of the Earthly "zero sum game" where one group's gain is another's loss.

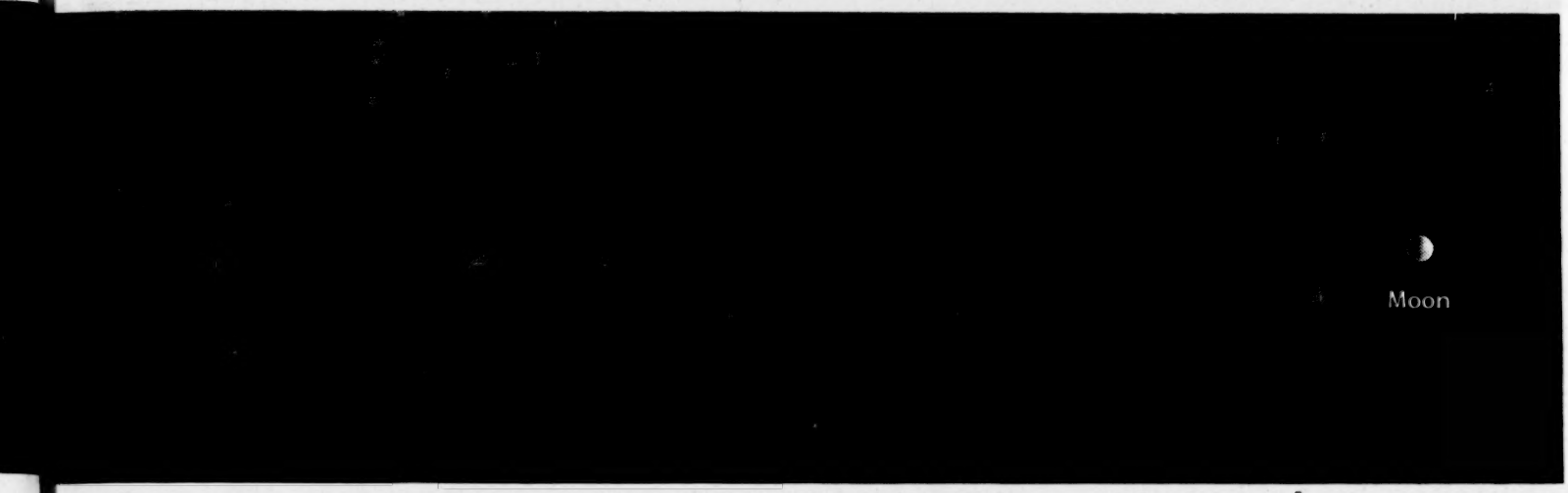
"North America all over again," is everyone's first response. "Now we'll pillage Space." Could be. But most of that thinking has scant comprehension of the nature of the Space environment. There's somewhat more than a lot of it. There is in fact no perceptible or theoretical end to it. Space is not like a continent, or the Pacific Ocean, or anything else we've experienced except possibly death and rebirth. It's more like a Buddhist chant: "No-air-no-gravity-no-night-no-day-no-up-no-down-no-motion-past-no-standing-still-no-life-also-no-death-no-thing-only-waves-of-star-star-star-star-star."

Space may teach us much about the Void. Still it is not the same. It has both emptiness and form, both measurable.

Its emptiness makes it highly predictable. Things go where they're pushed and keep going. Pioneer 6 was designed for a six-month life in Space when it was launched into solar orbit in 1965. Ten years and twelve times around the Sun later it's still going strong collecting and relaying solar data, with no reason not to expect another ten years out of it.

In de-emphasizing the exotic qualities of life in Space O'Neill is making a mistake I think. People want to go not because it may be nicer than what they have on Earth but because it will be harder. The harshness of Space will oblige a life-and-death reliance on each other which is the sort of thing that people romanticize and think about endlessly but seldom get to do.

This is where I look for new cultural ideas to emerge. There's nothing like an impossible task to pare things down to essentials – from which comes originality. You can only start over from basics, and, once there, never quite in the same direction as before.



Don Ryan

Earth and Moon, for once, drawn to scale. In this scale the nearest next item, Venus, would be seventy-two yards away. Between, nothing. Except sunlight.

So much for all the wonderful benefits of Space Colonies. Is there any likelihood we can politically get from here to there?

The most political argument against is the trade-off one – couldn't we spend $100 billion elsewhere more beneficially? I'm not so sure. The Apollo Program cost $25 billion, and as Government projects go it probably did more good, did less harm, and made more friends for America than anything else we've done since the Marshall Plan.

Next year, 1977, the U.S. is planning to spend $3.7 billion on Space, $10.4 billion on energy (mostly nuclear), and $101.1 billion for the Department of Defense. The B-1 bomber alone, which is supposed to replace the B-52 but has already been obsolesced by low-flying cruise missiles, is expected to cost $75 billion.

Now, I'm claiming that the prospect of Space Colonies gives us the best leverage on the Arms Race that we're ever likely to get this side of war. It employs the same nations, the same engineers, manufacturers, contractors, etc., and it's a more interesting story. The Arms Race is a big bore. Nothing ever happens.

Perhaps the leading U.S. and Russian Space planners should participate in the next round of SALT talks and turn them into Strategic Arms Conversion Talks. "We'll scrap the B-1 bomber idea and build a Model I Space Colony instead, if you'll do the equivalent." Conversion may be a great deal easier to monitor than Limitation – is the alternative project coming along or not? Look and see. It might even be that collaboration would have reason to replace competition – if only to check on each other's de-weaponization. Maybe Apollo-Soyuz was about something. America has better expertise in Space so far, but Russia has more imaginative long-range fantasies. And their astronauts sing better than ours.

I guess I expect that there will be much more public participation in Space Colonies than there has been in the Space Program so far. Debate such as in this issue. Public demand perhaps that new Space expenditures come out of the Pentagon's hide. Further international projects like Spacelab. And so forth. The difference being, after all, that each voter can consider using the program personally, can consider emigrating.

At least each young voter can, and that's where mass support seems to be building, among college age and younger. Most science fiction readers – there are estimated to be two million avid ones in the U.S. – are between the ages of 12 and 26. The first printing for a set of Star Trek blueprints and space cadet manual was 450,000. A Star Trek convention in Chicago drew 15,000 people, and a second one a few weeks later in New York drew 30,000. They invited NASA officials and jammed their lectures.

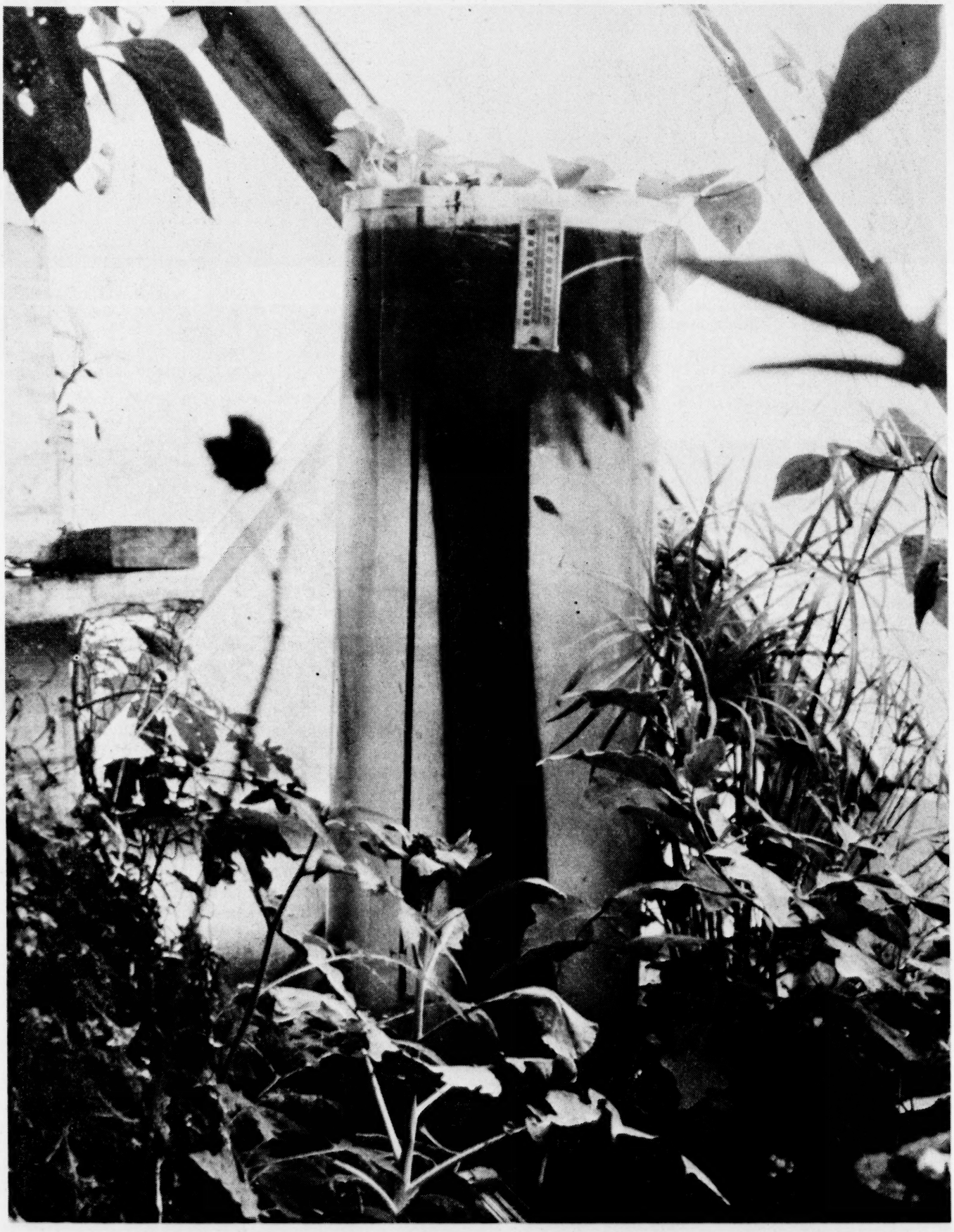
Now is the time for NASA to encourage people besides engineers to get into the act. The program needs administrators who are not afraid of excellent artists, novelists, poets, film-makers, historians, anthropologists, and such who can speak to the full vision of what's going on. And their voice needs to be a design voice, not just advisory. America (and Russia) were in Space for ten years before they bothered to get a photograph of the Earth. That's pretty arid thinking. There's no reason it has to continue.

To be sure, if the soft sciences and arts are let into the Space Program there will be constant argument and much silliness. Good. One of the best points that O'Neill makes for Space Colonies is that they lead to divergence – many visions travelling in many directions. That could become their best real function.

Ten thousand or one million or many millions of people in Space is somewhat about engineering, but it's mostly about people.

Returning to the question of Artificial vs. Natural, my friend Dick Baker has his doubts. Some years before he became a Zen abbot he worked in the merchant marine and observed that too long on board in a totally man-made environment tended to make the seamen a bit crazy. The same, he's noticed, goes for cities.

It's true, we make ourselves dishonest in worlds we have had too much of the making of. Still, "Natural" has a way of getting in through whatever barriers. As Baker-roshi said in another context, "From the Buddhist point of view everything is artificial." ■



Inside the test model for the Cape Cod ark. Amid a diversity of tropical and food plants, a "solar tube" traps and stores solar energy while culturing algae and fish. Sunlight enters the building through one layer of Kalwall and three layers of the Suntek membrane developed by Day Charoudi and Sean Wellesley-Miller. The habitat remains tropical in mid-winter Massachusetts.

The New Alchemists

BY JOHN TODD

The research of The New Alchemy Institute is:

1) *What will make O'Neill's Space Colonies work;*

or

2) *What will make O'Neill's Space Colonies unnecessary;*

or

3) *both.*

The Alkies have been much in the press in the last two years. Typical is this comment of Robin Clarke's in the Dec. '75 New Scientist*: "It is one thing to talk about Alternative Technology but quite another to get down to brass tacks and produce anything. . . . First and foremost, in the United States the New Alchemy Institute are still going like the clappers. Not only do they produce luscious publications, but they are getting good results, and their plans become ever more ambitious – the latest including a new low technology centre in Canada which looks like becoming the first wonder of the Alternative Technology world."*

But everything in the press has been about the New Alchemists rather than by them, and usually the emphasis has been on their flexible lifestyle rather than their hard science. This article by co-founder John Todd began as a letter to The CQ*, became a statement more definitive than anything they've done even in their own publication* The Journal of the New Alchemists*, and was used as the basis of John's lecture at that Texas Limits to Growth Conference last Fall.*

At the last minute the Todds added news and diagrams of the imminent project at Prince Edward Island, Canada. Both John and Nancy Todd (who edits The Journal*) were born Canadian. John was an Olympic skier and small-boat sailer in Canada before he became an agriculture scientist and marine biologist at McGill University, University of Michigan, and Woods Hole Oceanographic Institute.*

The New Alchemy work was begun to make projects like the Space Colonies obsolete. If instead it makes them possible the Alkies are going to feel strange indeed. A fundamental principle may be at work here, the Hegelian, Marxian, co-evolutionary one:

History proceeds by ironies.

–SB

The New Alchemy Institute was established in 1969 to explore scientifically strategies that might prove adaptive for humanity in the future. This was undoubtedly a large perspective for a tiny organization, but in an age of compounded crises and patch-it-up perspectives, it was clear to us that some fundamental and independent scientific thinking and investigations were going to be required and that the interfaces between science, politics and society were of legitimate concern for scientists.

At the outset we were acutely aware that despite our aggregate training (mine was in such fields as agriculture, parasitology and tropical medicine, ethology and aquatic sciences) we were not able in any concrete sense to design or comprehend the vital systems of society in their interconnectedness and entirety. We reasoned further that without some kind of wholistic comprehension there could be no really significant science for the future. Piecemeal thinking had about run its course, and an appropriate alternative was needed.

For us the key to change was linked to scale. If an adaptive future meant working with tangible wholes rather than abstractions, then the scale of our scientific inquiry should be much reduced, yet involve, at the same time, the vital systems which sustain humanity. We felt it imperative to fuse science with the practical, scholarly and philosophic realms. There were traditions to guide us, including the Taoist (in China) and Hermetic (in Europe), which at one time embraced science. In our own era cybernetics and ecology have helped pave the way for the fusion of which I speak.

GUIDELINES

Over the years we have adopted a number of scientific guidelines which incorporate political, economic and ecological considerations. Since they are relevant in any discussion of the value of our work, I shall list them:

Box 428, Sausalito, California 94965

John Todd recording the weight of a tilapia *corpse.*

1. That N.A.I. begin to design and research on a micro level while maintaining a planetary perspective and a concern for linkages between levels of organization. By micro level, we meant the lowest functional units of society, the individual, or small group, and the elements which sustain them. The assumption was that larger units of organization can be no stronger than the elements of which they are comprised, and that the microcosm can be knowable in concrete terms, often representing a tiny image of the larger world of which it is a part. It can, if broadly conceived, act as a model of organization. This perspective, which is characteristic of alchemical philosophy in many ancient cultures, inspired our name.

2. That N.A.I. emphasize food producing and energy systems that do not require large amounts of capital so that its findings could be widely utilized by those without substantial fiscal resources. This would also make its work useful, although by no means exclusive, to third and fourth world countries.

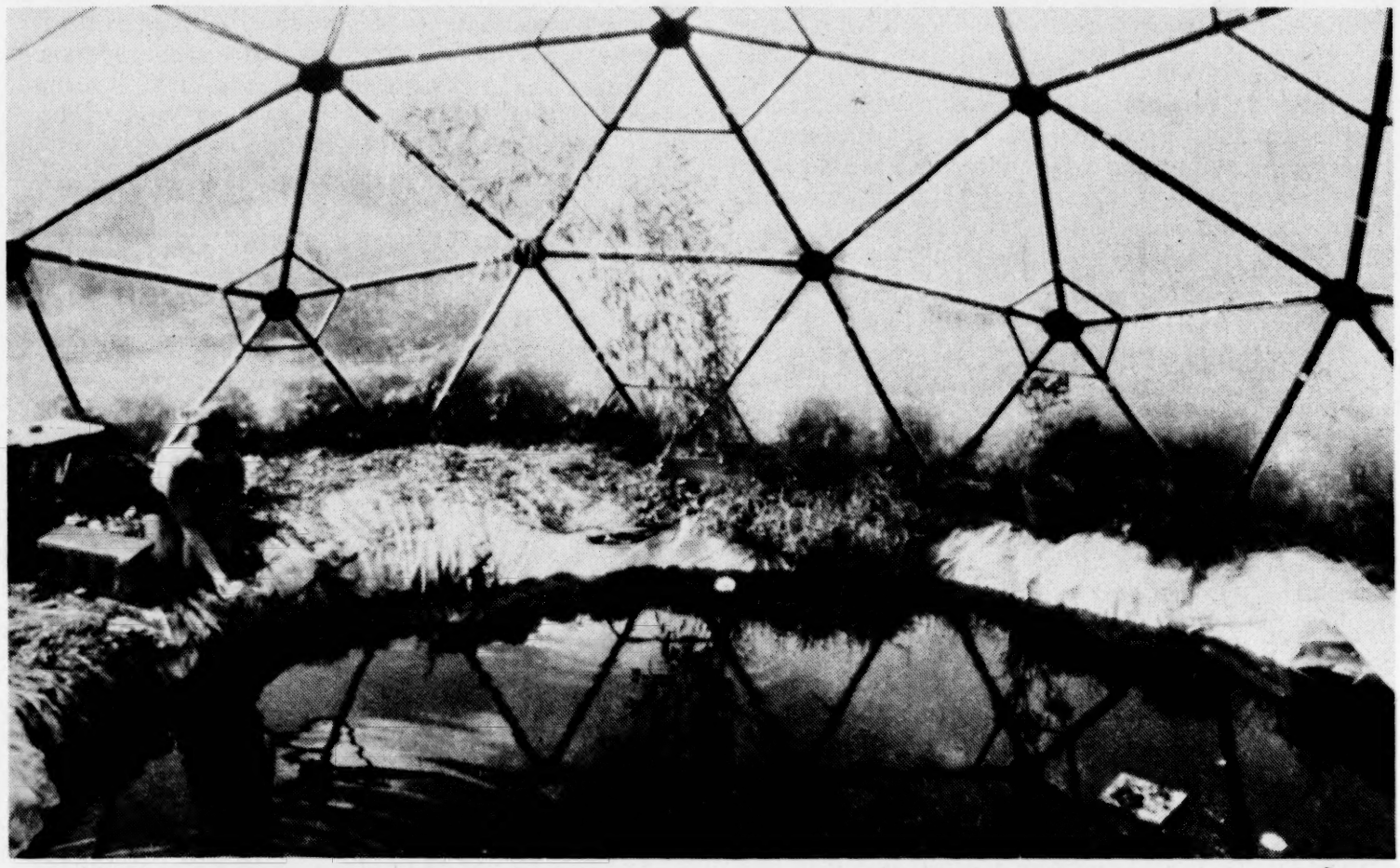
3. That N.A.I. seek methods by which a gradual shift could be made from a hardware-intensive society to an informationally and biologically extensive one. We suspect that the next major human advance may prove to be the substitution of strategies gleaned from nature deriving their primary support from natural systems, for present day predominantly hardware strategies requiring high levels of energy to operate societies. The integration of these newly designed natural systems may be assisted by microcomputers and monitors which utilize minute amounts of power and, like humans, act as control elements. We believe that in societies organized into micro units, almost all the food, shelter and internal climates, power, and even transport can be transformed to biologically and informationally derived support elements. Since it is more difficult to make a commodity out of living entities like an ecosystem, it seems possible that a future derived from this basis will be more egalitarian and considerate.

4. That in designing for the future N.A.I. emphasize participatory solutions which would be capable of involving large segments of society. We made the assumption that when the petroleum era wanes that the traditional ratio in which the great majority of humanity was involved in food raising would reassert itself. It has just been with the oil and gas based agriculture in the 20th century that it has been possible for a majority to shift to urban living. Since it seems likely at some future date that much of the population might have to return to culturing most of their own foods, we decided to research methods of food culture on a family level, which would be ecological and relatively inexpensive. The physical components would involve only part-time tending and be suitable for siting in such small spaces as suburban backyards. Further, they would have to be designed so as to be comprehensible and useful to large numbers of people.

5. That N.A.I. explore bioregional approaches to the future that would augment the more "universal" approaches outlined in 1 through 4. Towards this end, it would establish small centers or projects in several countries and climates. In the best of all possible worlds there should be a balance between the regional and the global. Each bioregion should be physically and culturally unique, reflecting a dialogue between society, climate, environment and resources. It seemed to us that self-reliance, price and independence could be restored in many regions if indigenous approaches to food production, energy, shelter and manufacture were given serious intellectual and scientific concern. At its fledgling centers the Institute has begun to identify and study bioregional directions in several areas as diverse as maritime Canada and the lowland tropics of Costa Rica.

6. That N.A.I. seek methods for incorporating in its designs renewable energy sources and durable material in lieu of finite substances and short-lived materials. Conserver societies will be predicated upon such shifts in energy production and use of materials.

In summary what we hoped to do was research methods for the fundamental redesigning of the vital systems which sustain human societies. We wanted to participate in creating a body of knowledge that could lead to the replacement of the fuel consuming engines and the hardware of present societies with equivalent support processes which would be derived from living systems coupled to sensitive technologies powered by the wind and sun. Nature in this context is our primary ally, the future must be nothing less than a transformation away from hardware intensive and exploitive societies to ones that are informationally rich, co-evolving in an intimate partnership with the living world.



Backyard fish-farm greenhouse. Plastic above (double-walled Kalwall) holds heat in. Plastic below holds water in. The water circulates through a cohog-shell and bacteria natural filter which removes the chemical signals by which the fish population would normally stunt its own growth.

EXPERIMENTS

I should like to outline briefly a number of our key experiments which are at present underway and which reflect the above approaches.

1. BACKYARD FISH FARM-GREENHOUSE

A number of years ago we posed a question – namely, would it be possible utilizing ecological principles, internal food cycles, and renewable energy sources for power, to produce the protein needs of a small group of people on a year-round basis in an approximately 50' x 50' space? Theoretically, at least, such systems might function initially as micro food gardens or survival tools. Ultimately they could point the way to a new approach to agriculture. New Alchemy's Backyard Fish Farm-Greenhouses are an outgrowth of our attempts to answer this question.

Basically the backyard micro-farms are semi-tropical aquatic and terrestrial environments covered by solar trapping structures which maintain and regulate year-round growing conditions for fishes, vegetables and some fruits and grains. The aquaculture component is key to climate control, as the large volume of water provides heat storage for cold and sunless periods. Within the ponds, dense blooms of algae are cultured, providing the feeds for herbivorous fishes within. Tilapia, a herbivore from Africa, has been cultured on internal food chains to an edible size in as short a period as 3 months. The white amur, another vegetarian fish prized in China, have grown to over a foot in length in less than a year. Overall productivity is dependent upon internal biopurification. This is carried out in two small ecosystems adjacent to the culture ponds. We have not sought record levels of fish production; our emphasis to date has been on the creation of healthy aquatic ecosystems which are almost autonomous, self-regulating and self-purifying, and which have incorporated into them a variety of food cycles, the end points of which are diverse foods suitable for human consumption. These include fishes and edible aquatic plants such as water chestnuts. Rice has been successfully cultured in small batches using pond water. Production in shallow 18' diameter dome-covered ponds has exceeded 50 lbs. per crop of tilapia which are cultured only during the summer months. White amur and mirror carp are raised year-round in the same system.

Adjacent to and dependent upon the aquaculture are experimental terrestrial growing beds. During summer they contain tropical seed grain crops such as amaranth, vine crops such as squash, cucumbers, and tomatoes, and tropical fruits. During the winter, traditional temperate climate foods such as spinach, lettuce, onions, parsley and chard are grown. Their overall value may exceed that of the fish. Pests upon the plants are controlled biologically; *Anolis carolinensis*, a lizard, has been found an effective predator for most insects. Biocides can not be used

within these terrestrial capsules as they disrupt the internal cycles, particularly the aquatic.

Although the original concept has been vindicated, there is yet much to be learned. Our growing structures are now at a stage where they are justified at the family level. Perhaps in some parts of the world, where food and water as well as fuels are scarce, adaptations of these micro-farms could prove extremely valuable.

2. THE MINIATURE ARK

The miniature ark, a solar-heated wind-powered food-growing complex was designed to study biological concepts which we hope will lead to highly productive and economically valuable ecosystems for the raising of aquatic foods. It has in addition a small amount of greenhouse capacity. The design was inspired by productive ecosystems in nature, in particular a river in Java, a Louisiana estuary and a mangrove lagoon in Florida. All three ecosystems were characterized by rapid exchange and flushing rates of water which we felt were key to their ability to sustain large animal populations. The river had high nutrient levels derived from animal and human sewage and was capable of sustaining immense populations of organisms suitable for fish feeds. The Javanese cage-culture 80-90,000 lbs. per acre of fishes annually in the better sections of the river. Both the Louisiana estuary and the Florida mangrove lagoon were characterized not so much by high internal productivity as by accumulations of decaying detritus derived from surrounding terrestrial and aquatic environments. Because of the influx of oxygenated water from outside, large numbers of fish and crustacea were able to thrive in these zones to feed directly on the abundant detritus and associated organisms. In the absence of flushing, decomposing organic matter lowers oxygen to levels intolerable to desirable fish and crustacea species.

The miniature ark was designed to incorporate the best bioenergetic attributes of the tropical river, estuary and lagoon with respect to overall stability and productivity. Its aquaculture component is a circular "river" or closed loop, with solar heated water, high nutrient levels, a rapid flow with resulting high exchange rates, detritus, organic matter, and supplemental components for culturing additional feeds.

The flow is produced by a windmill which pumps water through the various subcomponents of the loop. Several high capacity sailwing windmills have been developed by New Alchemy for water pumping in third world countries and for aquaculture systems. Presently the Institute is attempting to develop pumps equal to the power of the windmills. It is expected that, within a year, flow rates on the miniature ark will increase four fold with a concurrent rise in potential productivity.

Large fish populations are cultured in the largest pond of the loop or cycle. Bio-purification takes place, after the water has passed through the solar heater, in five small ecosystems. These variously house bacterial filters comprised of shells, earthen filters, open pools and "forests" of aquatic plants arranged to induce alternating carbon dioxide and oxygen dominating pulses. The ability of the system to purify water ladened with toxic fish wastes has exceeded our most optimistic estimates. Plants from the bio-purification elements are fed to fishes periodically. In this way the nutrients are continuously recycled within the system.

Although the aquaculture component of the miniature ark is small, it has worked well and will be the model for larger systems. The design and early workings of the miniature ark and the backyard fish farm-greenhouses are described in the **Journal of the New Alchemists**, Volume Two.

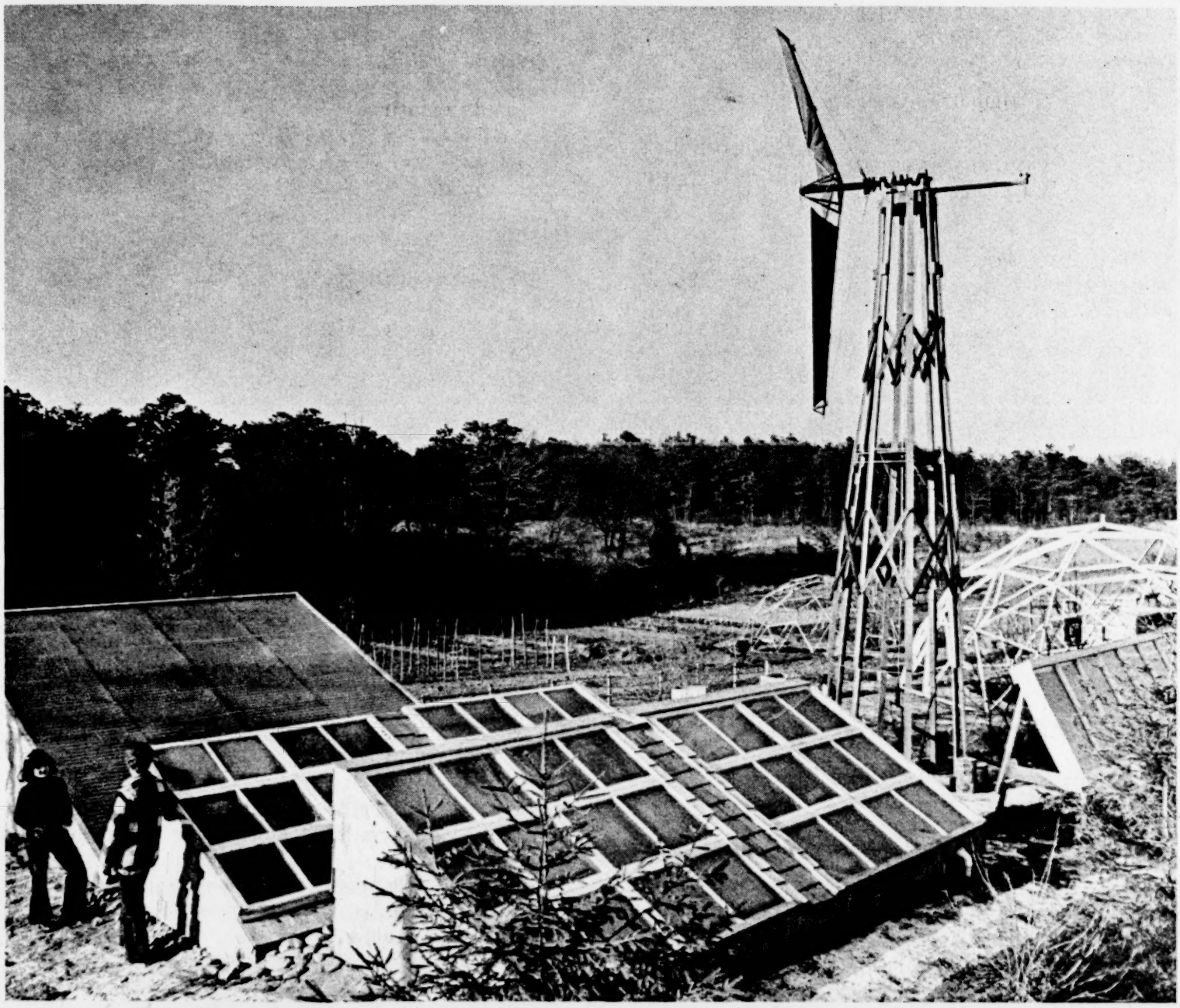
3. SOLAR PONDS

The recently conceived solar pond concept is an attempt to utilize living systems so that they serve simultaneously a number of critical functions in an integrated way. In their design the emphasis has been to have biological entities, in combination with an appropriate technology, serve roles presently played by machines and fuels. The solar ponds are an attempt to create suitable climates in living and food growing bioshelters while at the same time they perform as aquaculture ecosystems. As such they are an example of guideline 3.

The solar ponds are translucent cylinders of water placed above the ground into which light can enter from the top and all sides. Their walls and tops are built from a Kalwall fiberglass material which permits a high percentage of available light to enter. Solar ponds act as both effective solar collectors and heat storage units. The planktonic algae absorb the sun's energy in much the same way as the black absorber surfaces of the plate collectors which are manufactured for houses and buildings. Within the ponds the energy from the sun is transformed by the plants into heat and plant growth. The water medium within which they exist is an appropriate storage material. A covered solar pond 5' high by 5' in diameter heats rapidly when the sun shines brightly. During the warmer months partial shading and venting is required even when they are outside.

In New Alchemy's "Ark for Prince Edward Island," which is a solar-heated and wind-powered bioshelter encompassing a house, laboratory, greenhouse and aquaculture facility, there will be forty solar ponds. These will contribute considerably to maintaining living and growing climates year round, as well as providing the backbone of the aquaculture systems. The Solsearch architects who are working with us on the structure predict that the ark will be able to function in the Canadian maritimes if the sun does not shine for a month. The complex will be one of Canada's contribution to the U.N. Human Settlements year.

The solar ponds represent a new approach to warm water fish culture. Because of their phenomenal light-receiving ability, algae production on a per unit volume basis is some ten times greater than in



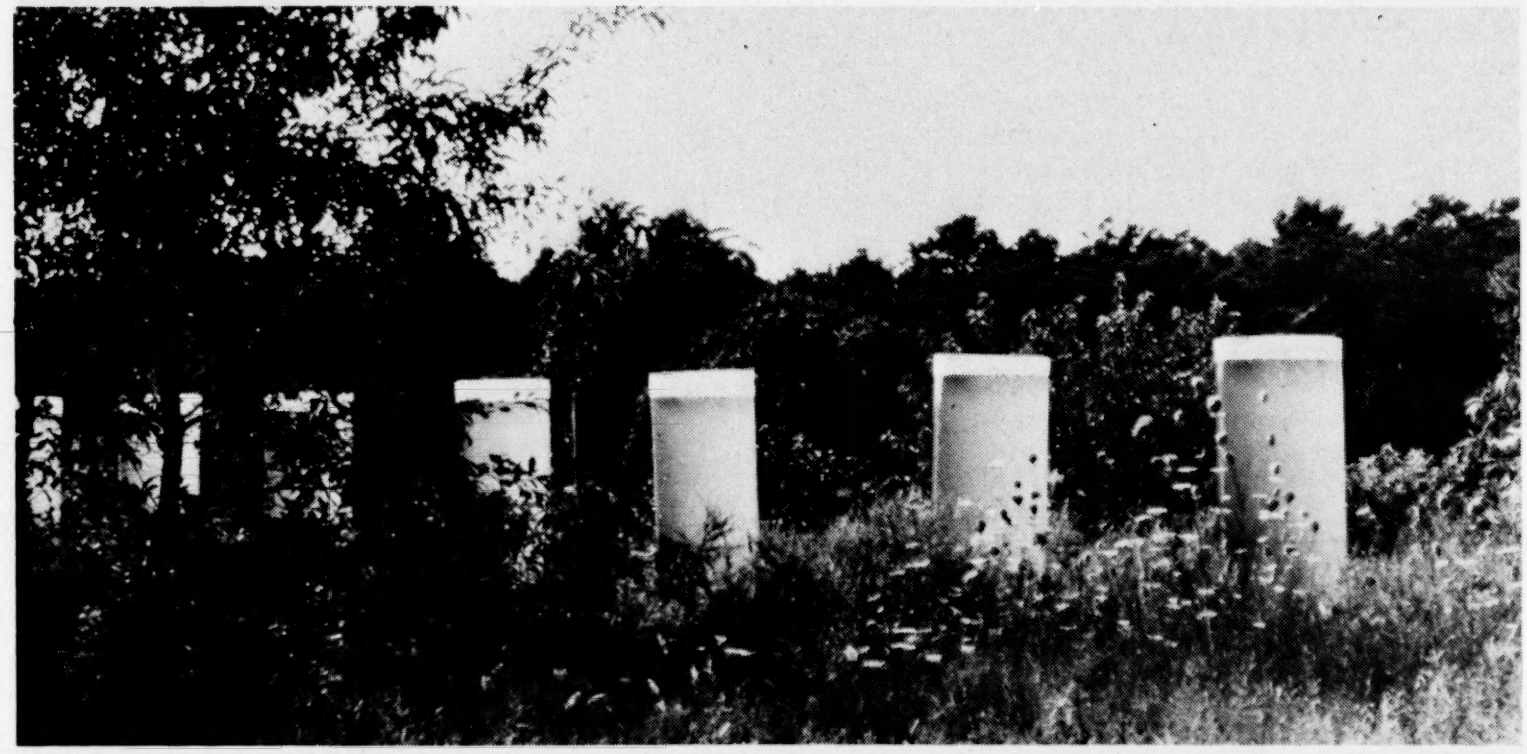
The Mini-Ark, a closed-loop stream. At right, the solar water heater. Foreground, the bio-purification unit and supplemental food sub-ecosystem. To the left, the polyculture fish pond and terrestrial plant greenhouse. The sailwing windmill has a reciprocating rod leading downward to a wooden box pump (which outperforms and outlasts commercial plastic pumps). The windmill lifts the water in the "stream" to its highest point.

our other aquaculture systems. Consequently, proportionately larger grazing populations of tilapia are presently being cultured in them. Within the ponds, we are experimenting with passive vs. active bio-purification strategies. The "active" solar pond uses a small 5 watt air pump to turn over water within bacterial filters on the bottom of the pond. This has resulted in extraordinarily dense algae blooms.The "passive" solar pond seems to be able to function effectively as well by relying upon the movements of the fishes to affect bacterial-algae nutrient recycling. Both solar ponds have an exceptional ability to take up and eliminate toxic ammonia.

Since this is our first season working with solar ponds it would be premature to judge their worth as solar heaters and fish culture ecosystems. However this winter we have two solar ponds with double transparent walls and lids sitting outside in an exposed position. Within these ponds we are culturing Israeli carp and silver and bighead carps from China. Already they have had to face howling winds and temperatures of 2° F. Water temperatures within have not dipped below 40° F., and as soon as the sun began to shine they started to heat up. Quite amazing. Right now we are building a mylar coated windbreak-reflector to optimize their solar trapping ability. With more study and refinement the solar panels may prove to be one of N.A.I.'s most valuable contributions to the vexing problems of heating and food production.

4. THE CAPE COD ARK

We intend to find out whether well-designed bio-shelters can be developed that will produce foods in such abundance to be economically viable, paying for themselves and providing a living income



Solar tubes, 18" diameter, 5' high, housing algae and tilapia *feeding experiments.*

for their owners. An intensive garden/farm agriculture, based on small acreages and bioshelters which contain ecologically derived food networks powered by renewable energy sources, may be a most adaptive strategy for a future when fuels are dear and in short supply.

The Cape Cod ark, a solar-heated, wind-powered greenhouse and aquaculture structure, was designed in collaboration with Solsearch architects to explore the micro-economic basis of the bioshelter concept. It is to be built in 1976 if enough support for the project can be found. A small model, 25' by 15' in size, has already been built to test a number of concepts and materials. These include the insulating and heat-trapping properties of the potentially valuable solar membrane invented by Jean Wellesley-Miller and Day Charoudi of the Solar Lab at M.I.T. The model ark is the first test of the membrane within a growing structure. It is suspended in three layers under the south-facing fiberglass wall. The membrane may be an effective alternative to costly, difficult to manage shutter systems in solar heated growing structures.

It should be emphasized that the Cape Cod ark is a first attempt to design and build a commercial-size growing structure incorporating the principles described earlier in this letter. Much biological and bioengineering research will be involved, including the evaluation of crops most suitable to conditions within, biological controls for pests and disease, and internal climate regulation. We are optimistic that such arks eventually will prove an important alternative to food scarcities when cheap fuels wane, but we are aware of the amount of work required to realize their potential. We also feel an obligation to design them so that they are not dependent upon experts and can be widely deployed through society.

5. AN ARK FOR PRINCE EDWARD ISLAND

The Canadian ark is a complete system for living, research and food production which is autonomous and self-contained. It uses the sun and the wind to create housing and growing climates under the rigorous climatic conditions of Prince Edward Island in the Gulf of St. Lawrence. Presently under construction, it is New Alchemy's first attempt to test the feasibility for future living structures which are not continuous energy drains on society. They would be long-lived structures that generate their own power, utilize their own wastes and provide food and even commercial crops for their inhabitants. Through the ark we are trying to evolve bioshelters which are, in many respects, miniature worlds and will through the tending of them teach their inhabitants how the larger world works. An earth ethic may well have to begin where we live. If this is so, our houses should emulate the workings of nature.

A brief description of the ark for Prince Edward Island will appear this fall in the third **Journal of The New Alchemists**. The artist's illustration shows what it will look like when viewed from the sea to the south. What makes the ark unique, apart from its self-sufficiency, is the careful integration and the linkages between components which have not been connected traditionally. The greenhouse element, the solar ponds and the solar collectors, for example, all trap and store the sun's heat in several subsystems which, in turn, will be used for a diversity of vital functions. The 25kw wind-driven power plant will provide the electricity for control functions and for air and water circulation. During critical periods in winter, its electricity will be degraded to provide heat to subelements that require it. The ark will be very much like an organism, with the structure acting as the exoskeleton. We shall study the various

interrelationships between such external inputs as sun, wind, length of day and temperatures, and internal biochemical, biological, climatic and storage variables. The emphasis will be on discovering the most appropriate ways of regulating the overall system and of optimizing on a sustained basis food production within.

During a period in history when, in temperate countries, fuel for heating and for food growing, transport and storage are rapidly consuming a high percentage of the world's finite energy sources, arks may represent a key step in integrating existing knowledge with indigenous, smaller scale approaches to the future.

6. HYDROWIND* – AN ADVANCED WIND-DRIVEN POWER PLANT

For many organizations a challenge may occasionally arise which seems sufficiently important that a change in course may be advised in order to meet it. On Prince Edward Island we have been confronted with just such a challenge. The Island province was planning to take part in a large nuclear project, but indicated to us that there was still time for other alternatives to be seriously considered. We proposed informally to the Premier and some of his cabinet and staff that a non-nuclear future might prove the wisest course both socially and economically. N.A.I. is opposed universally to nuclear power generation. In the case of Prince Edward Island, we recommended a gradual shift to a coal-wind-solar energy future. The wind is a renewable and plentiful island resource and coal is readily available in Nova Scotia.** With about 2,000 hours of bright sun annually, the Island could well integrate supplemental heating into its buildings and crop driers, thereby reducing its fuel and electricity needs. Unfortunately, our arguments were weakened by the fact that there was no commercially available electricity-producing windmill either large enough or suitable for determining the efficacy of wind as a supplemental power source. In order to keep alive the ideal of a non-nuclear future, the Institute, with promised support from the Canadian Government, brought together a team of engineers (Merrill Hall and Vince Dempsey) to develop a New Alchemy windplant. Several design criteria were drawn up for it:

1. That it be rugged enough to withstand fierce winds and salt spray along the Island's coast;
2. That it have the potential to be scaled upwards in size to 100kw systems and larger;
3. That the first plant produce enough electricity to power readily a sizeable farm or the ark (a 25kw mill size was chosen);
4. That the design permit it to be ultimately manufactured and assembled on the Island;
5. That its economic future look promising.

*A trademark of The New Alchemy Institute.

**The Province of Prince Edward Island recently decided against a nuclear future for the Island. This represents the first political decision in North America against nuclear power. Hopefully the decision by Premier Alex Cambell and his cabinet represents the beginning of a new trend. New Alchemy's obligation to the province's energy future was much increased as a result of their decision.

Exterior of Test Model for Cape Cod Ark. Panels of Kalwall are arched for more effective solar trapping. Design by Solsearch Architects.

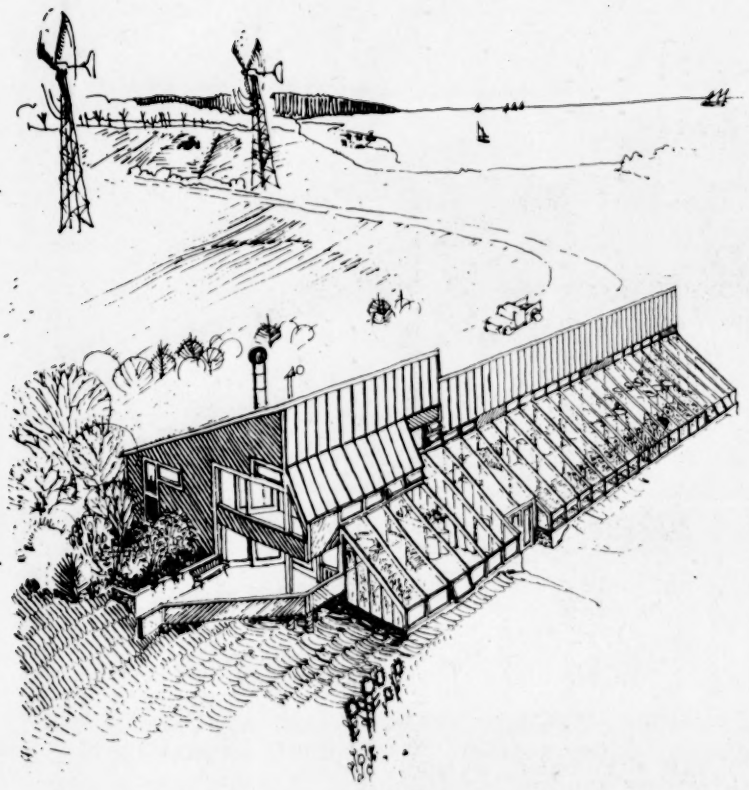
The resulting design was the HYDROWIND windmill electric power system. It represents a break from orthodox windmill technology. A prototype is now under construction, to be tested on Cape Cod. The HYDROWIND uses hydraulics for power transfer, taking advantage of substantial improvements in hydraulics in recent years, where power transfer efficiencies are now higher than 90%. The New Alchemy system transfers power via hydraulic pumps from the blades to a hydraulic engine on the ground, at which point it is transformed into electricity. There are a number of advantages to be gained, including increased ruggedness, smaller towers and top gear, potentially better air shapes due to having generators on the ground, hydraulic tuning of the blade pitch and opportunities for a scaling of size. Perhaps most important, inherent in the design is the ability to couple a number of windmills into the same power plant and operate a single generator.

The first HYDROWIND power plant on Prince Edward Island will be comprised of four 20′ blade diameter windmills linked together. The blade design is new, involving an integral core tension system and a light-weight aluminum skin.

The power plant will be connected to the ark and also to the Island's power network. We feel it will be valuable to test the mill on the grid in order to establish the feasibility of having windplants contribute to existing networks. It is our hope that an active debate will arise, on the Island and elsewhere, as a result of the ark system which will produce more power than it needs and sell the extra power to the utility.

7. RELATED STUDIES

There are a number of other studies and projects within the Institute including the culture of insect larvae as supplemental fish feeds, diet studies on fishes, the evaluation of plants and animals from around the world for use in bioshelter food chains, tree crops and food drying and preserving. Efforts are being made to learn more about biological methods for increasing soil fertility and managing

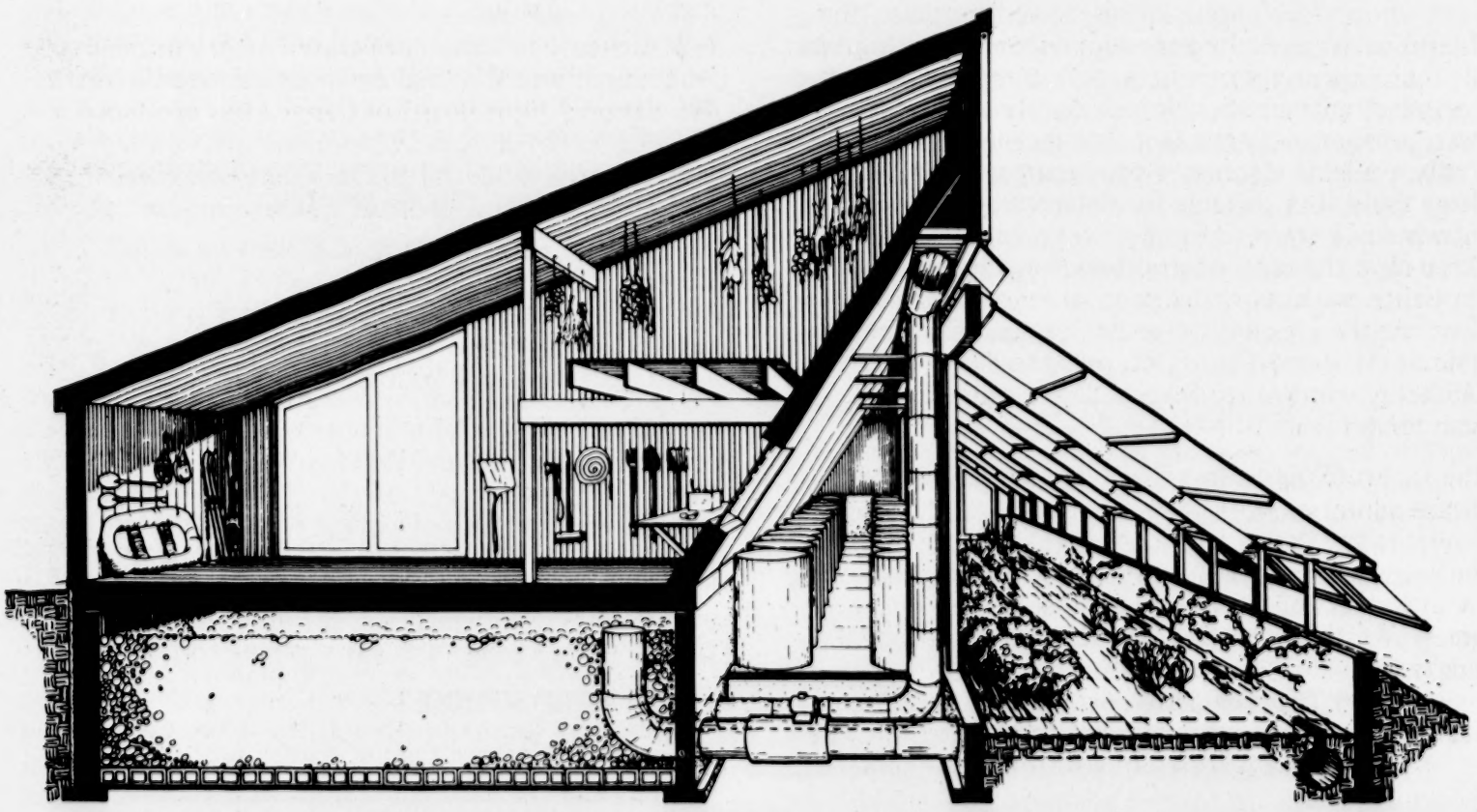


Prince Edward Island Ark. South view of solar and wind-powered bioshelter housing living facility, research laboratory, family garden area, and commercial fish culture and greenhouse facilities. 850 sq. ft. of solar collectors. 2,500 sq. ft. of greenhouse panel.

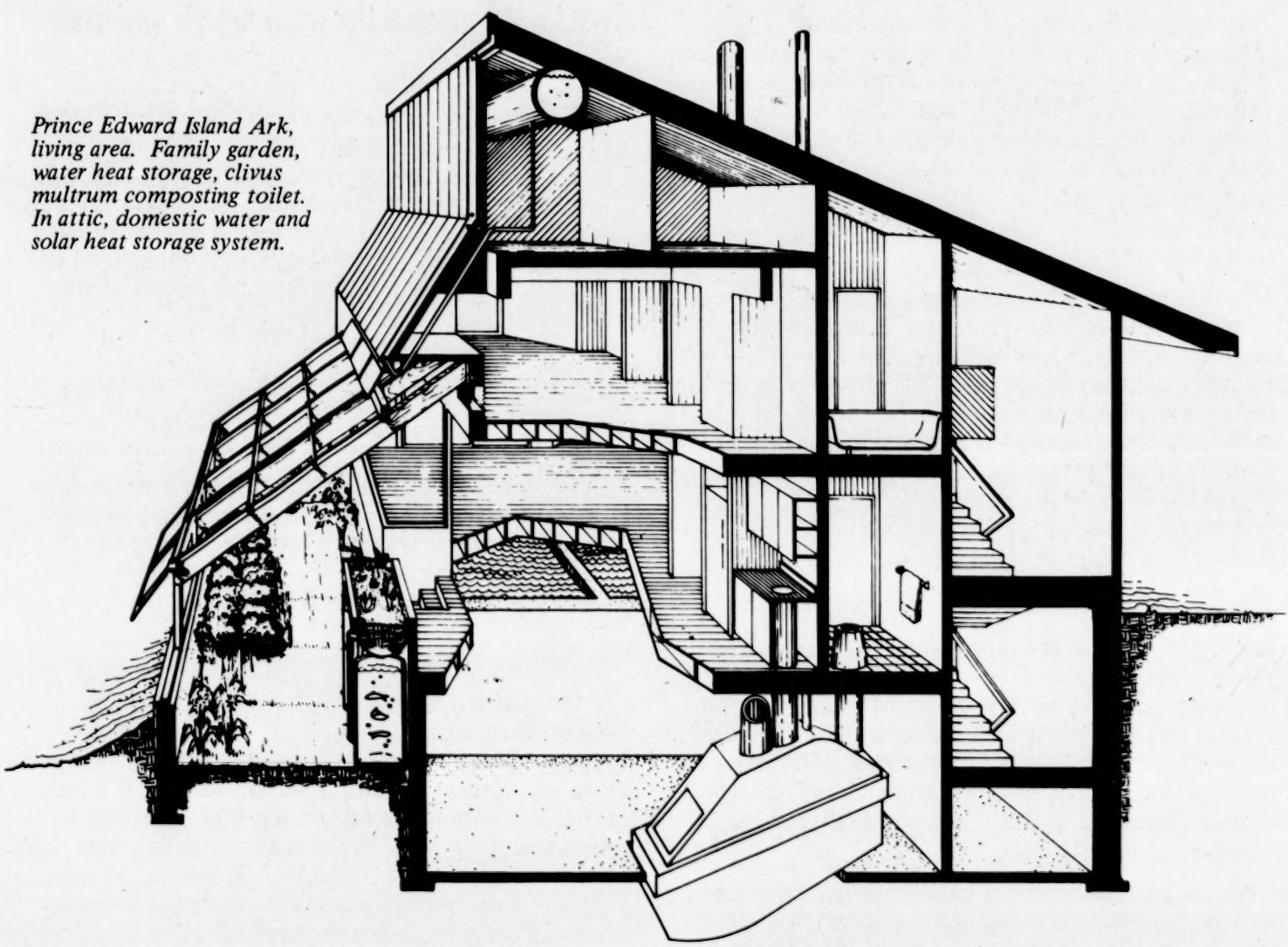
crops. Most of these studies are related and reflect a desire on the part of the staff to find more apt methods of managing living resources on a small scale. Central to our efforts is the testing of crop varieties for insect resistance and suitability to various climates.

8. DISSEMINATION OF INFORMATION

The Institute is unusual as a scientific and information gathering organization in that it publishes most of its materials in a form directly usable by the public. We have bypassed the usual course of allowing information to circulate through scholarly journals before passing slowly outward through various extension agencies to the public, in the main because of our feeling of the urgency of the work at a time when the future seems almost at hand. We are also interested in direct feedback from those utilizing concepts developed at the Institute. The fact that we communicate purposefully and directly with the public has caused resentment amongst some of our scientific peers, perhaps in part because we are trying to make the search for useful knowledge less sacrosanct, and in part because we are not usually involved in elaborate peer review processes that normally affect publications, invitations to conferences, promotions, grants and tenure. We do not hold, however, that scientific publishing is in any way invalid. On the contrary, without it much of our work would be severely hampered.



Prince Edward Island Ark, east end. Lower left, greenhouse rock heat storage. Above, barn for vehicles, machinery, and plant drying. Center, connected "river" of solar ponds for fish-raising. Right, greenhouse.



Prince Edward Island Ark, living area. Family garden, water heat storage, clivus multrum composting toilet. In attic, domestic water and solar heat storage system.

The New Alchemy Institute has become involved in a dialogue with staff members from a variety of field organizations including OXFAM, The Intermediate Technology Group in Britain, Save The Children Fund, V.I.T.A., Church World Service, Rural Development Fund, Brace Research Institute, and a number of less well-known organizations and communities throughout Canada and the U.S. We expect this list will increase as we gather more useful information. At the present, lack of funds and staff have limited our outreach efforts, but this winter N.A.I. – Costa Rica, under a small grant, will work directly with farmers on a study of native crops.

The Institute publishes an annual **Journal** which is a compendium of work that has been tested, along with scientific and social articles. In some of the writings there are attempts to grasp the larger picture and to see ourselves and others within the framework of the times. We plan each issue of the **Journal** to have a long period of usefulness. In the past, five thousand copies of each **Journal** have been printed and all but a few copies have been either sold or sent to Institute members. Requests for them come from all parts of the world.*

***The Journal of The New Alchemists can be ordered from Box 432, Woods Hold MA 02543. Vol. 1 costs $4. Vol 2 (with "The Compleat Backyard Fish Farmer") costs $6. Vol. 3 (brand new) costs $6.**

Membership in N.A.I., a nice way to support it, costs $25.

—SB

New Alchemy has also cooperated with a number of publications and film makers in explaining the work. The National Film Board of Canada has produced a film entitled "The New Alchemists" and has hired several people to show it to audiences throughout Canada. It is being distributed in many countries, including the U.S.

9. ORGANIZATION

While the Institute has a formal structure and a board of directors, decisions are made by all its staff members at a weekly meeting. It is well organized internally. Each staff member is expected to explain and coordinate his or her activities with others effectively, to optimize use of time, talent and money. Our growth has been purposefully slow mainly because we desire first to know well all new staff members. Several of us began collaboration as friends before the Institute was formed in the mid-sixties.

From the outset we did not wish New Alchemy to be dominated by scientists, though we were primarily a scientific organization. We wanted the Institute to reflect a balance between scientists and technical people, administrators, humanists and generalists. The sexes are balanced, and at the present such essential areas as publications, office management, agricultural research and garden studies are headed by women. About one fourth of the staff have Ph.D.'s and everybody is skilled in one or several aspects of

the organization. Mutual interdependence is stressed not only in decision making but in the salary policy. In 1975, we adopted a single salary policy ($9,000 per year plus child allowance) for permanent members. Several of the younger and newer people do not receive this pay but are assisted with subsistence incomes, food and lodging until salaries can be found. They have proven themselves genuine assets to the organization.

New Alchemy's main center on Cape Cod has a staff of sixteen and several volunteers. There are also under contract with N.A.I. two full-time architects and one full-time member of the windmill group. The remaining four windmill people and several energy and materials experts assist on a part-time consulting basis. The architects and the windmill people are supported by New Alchemy in Canada. Partial salaries for a number of the full-time staff have come from the Canadian center as well.

10. SOURCES OF SUPPORT AND BUDGETS

In the U.S., N.A.I. is supported by individuals and private foundations. There are presently 2,000 associate members of New Alchemy, each contributing $25 or more annually to assist us financially. In return they receive the annual **Journal**. Our long-range plan is to seek an increasing amount of help through members, but it is not yet clear whether or not this is a realistic aim.

Over the past few years, a number of private foundations have contributed grants, usually on a one-time basis. Without their support we should not have survived. Included among them are: the Stern Family Fund, the Rodale Soil and Health Foundation, POINT Foundation, LARAS, Septimus II, Haymarket Foundation, Jessie Smith Noyes Foundation, Rockefeller Brothers Fund and the ARCA Foundation. Grants have ranged in size from $2,000 to $50,000. As yet we have neither a long-range commitment from any foundation, nor an endowment. Only the Advanced Concepts Center of Environment Canada has discussed with us the possibility of long-range support for biological research on the Ark for Prince Edward Island.

Our annual budget from 1 July 1974 through to 30 June 1975 was $147,000. Our income did not effectively support the Institute during this period. Three staff members worked part of the year at the Woods Hole Oceanographic Institution, and three spent part of the year without salary in India and at N.A.I. in Costa Rica. One member was in a financial position to work without pay and several of the newer staff worked at part-time jobs to make ends meet. Canadian support, not reflected in the above figure, permitted the planning and design work on the ark and the HYDROWIND power plant to continue.

July expenses of approximately $20,000 more closely approach our monthly needs. We have estimated that we will need about $225,000 for 1976. Less than one-fifth of this amount has been contributed or earmarked for the Institute. In short, our financial situtation is not good.

WHAT WE WOULD DO WITH MORE SUPPORT

1. General Support

Our continued survival and strength as an organization depends upon all of the staff receiving modest but livable salaries, and our continuing to have enough to rent and maintain the center's Cape Cod lands and facilities. For this reason, general Institute support is integral to our effectiveness and is considered our first priority. Beyond this there are several distinct areas in which we need help.

2. Winter Aquaculture Research and Laboratory Facility

We have leased an old dairy barn for fish and aquatic plant breeding and cultivation experiments, and for a soil and water chemistry laboratory and additional office space as well. To provide heating and to outfit the facility $10,000 is needed. Much of the labor involved in building it will be our own.

3. Test and Analysis Equipment

In the past we managed by borrowing scientific instruments when we could get them and through using unsuitable monitoring and research equipment. One of the most serious problems we face is a lack of suitable equipment to study the biological and technological systems we are creating. For example, light sensors, recording thermistors, pH meters, oxygen and ammonia recording electrodes connected to multichannel chart recorders are needed for us to elucidate the fundamental interrelationships within the bioshelters and for comparative studies between the various food producing ecosystems. Continuous recording soil tensiometers, humidity and temperature recorders are required for greenhouse and field soil studies under differing management and climatic conditions. For soil and water analyses, more chemicals, reagents, and glassware should be obtained.

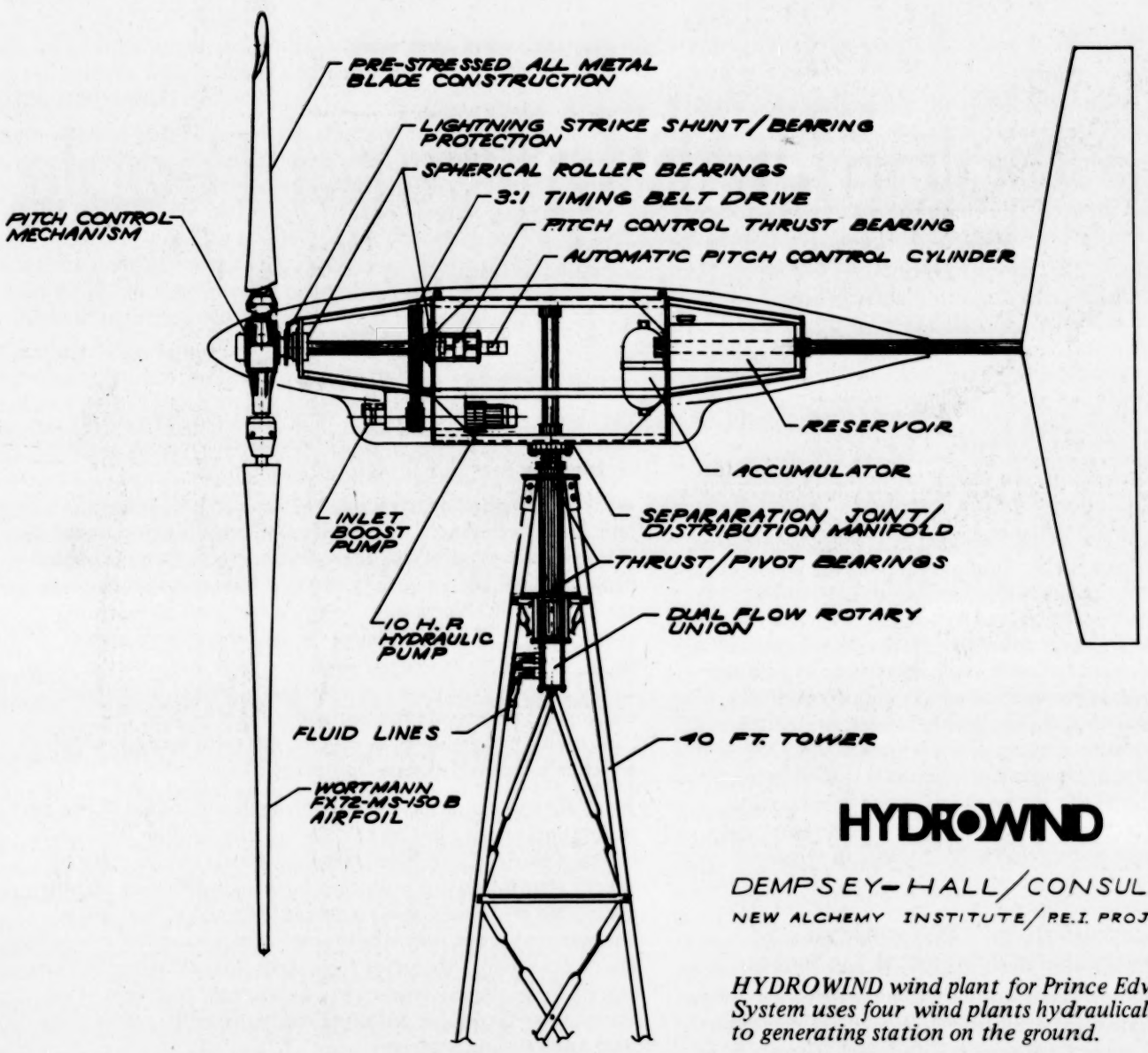
For testing the HYDROWIND, the windmill team will require 2 DC output 6-channel chart recorders to which thermometers, barometers, anemometers, wind direction indicators and vibration sensors are connected. Beside the sensors just mentioned, they will need two tachometers, two kilowatt hour meters and two recording voltmeters.

4. The Journal of The New Alchemists

The publishing, printing and distribution of the **Journal** costs in the neighbourhood of $23,000 annually. With grant support it could be distributed more widely and at lower cost. It will remain our major medium of communication.

5. Library

N.A.I has a small but useful library. We have permission to use the Marine Biological Laboratory and the Harvard libraries. We require several thousand dollars for inclusion in our library of the best standard references and texts in fields we consider part of our domain.



HYDROWIND wind plant for Prince Edward Island. System uses four wind plants hydraulically linked to generating station on the ground.

6. New Staff

Should our operating expenses be met and our facilities completed over the next few years, we should consider increasing the staff by one or two people. Positions being talked about are: i. a full-time electrical and mechanical person for repairing and upgrading physical components; ii. a competent terrestrial ecologist who might be available on sabbatical; iii. a replacement for one of our people so he or she could take some aspect of our work directly into an existing community. No new staff will be considered until the financial picture of the Institute is stabilized and improved.

THE FUTURE

I should like to end by emphasizing that the various systems briefly chronicled here represent concepts in embryo. They are not end points, but new beginnings. They may seem simplistic, even quixotic upon first reading, as in some respects they are, but to see them only in this light might be akin to judging the worth of modern physics from a painting of Newton's laboratory. Within the next few decades many of these ideas will mature, particularly if the impetus can be maintained and others share some of the perspectives presented here. Several years ago I suggested that modern societies by nature would be in opposition to utilizing small scale, wholistically derived biotechnologies in designing communities of the future. At that time it was necessary to justify our research on the grounds that it behooves a mature society to explore diverse strategies for the future simultaneously so that when decisions are in order there are a variety of options to select from. This perspective, while central to our thinking, has been transcended recently by a growing awareness that new strategies for the future are required immediately and urgently. In part this realization is arising out of a waning confidence in the ability of science and technology to salvage an industrialized growth-oriented society in an ultimately finite world. It is becoming apparent that a science of steady states is needed to prepare us for the future. It will be different from the one we now know, having been created within a framework of ethical and moral considerations. There is emerging a widespread interest in building a future in which the majority of people are participants rather than spectators. New Alchemy's long-range survival as a viable and effective organization will depend in a large measure upon many people finding meaning in more tentative, small-scale approaches to the future of humanity. ■

Space Colonies, Ethics, and People

BY J. PETER VAJK

Can we colonize space in the next 15 years? If so, should we colonize space in the next 15 years?

The first of these questions is a matter of nuts and bolts, of dollars and cents, of blueprints and cost/benefit ratios, and it is amenable to hard, technical analyses. The answer appears to be YES.

The second question is a matter of values and attitudes, of ideology and metaphysics, and is much harder to discuss. But the issue must be confronted, no matter how heated the debate. From one point of view, such discussion is a golden opportunity for mankind: we are on the threshold of a major technological innovation, and it is possible, before we commit ourselves to implementing it, to examine the social, political, and philosophical impacts it is likely to have. In any undertaking as massive as space colonization, it is vitally important to set the tone for the endeavour very early, so that we are not carried away blindly in whatever direction purely engineering considerations launch us. Since we collectively create our own future, it is possible to steer the course of space colonization, within a wide range of choices, in the most beneficial directions we can foresee.

This kind of analysis of space colonization might be called an "ethical impact statement," and it is no less important than an environmental impact statement. Obviously, there will be overlaps between the two impact statements, and I will point out some major environmental factors below. But what I want to stress in this discussion is the implications for society and for the quality of life of people, whether they happen to live in the space colonies, in affluent American suburbs, or in agrarian villages in India.

On a purely materialistic basis, space colonization offers new solutions for at least three problems: a new source of clean, non-depletable energy, a new supply of raw materials for industry, and new lands for human settlements. This invites the obvious charge that it is a "mere technological fix" – just like solving traffic jams by building more highways, until we finally see that our supposed "solution" has become part of the problem. More highways seem to encourage more cars, leading to bigger and bigger traffic jams.

The popular wisdom currently holds that purely technological fixes are "bad" because each technological "solution" creates five new and different problems. But the reverse side of the coin is surely just as valid: purely societal fixes are also "bad" because each societal "solution" creates five new and different problems!

What it is important to recognize here is that it is not relevant whether a "fix" is societal or technological; what matters is whether or not the consequences of any proposed program have been carefully thought out, and that steps be taken to forestall or minimize any adverse effects on the system and its parts. We must recognize and accept this fact: we will always be involved in a co-evolutionary process. Every change in any part of the system results in changes elsewhere in the system; eventually the effects of the "solution" propagate back as new, different stresses which are then perceived as new "problems."

What are the major problems confronting mankind in the next generation or so? During the Sixties, the popular wisdom in North American and European intellectual circles came to accept that increasing pollution from industrialized societies, dwindling non-renewable resources (especially fossil fuels), and exhaustion of potentially arable lands were fast becoming major problems. Scenarios for nearly total catastrophe from any of these causes were widely publicized, and were often accepted at face value without first being subjected to skeptical analysis and criticism.

Perhaps the most famous of these scenarios resulted from some work in 1970 under the encouragement of the Club of Rome by Jay Forrester at M.I.T.'s Sloan School of Management. Forrester developed a fairly simple mathematical model of the world socioeconomic system, which he called "World Dynamics." In this model, the world system is described in terms of five principal variables: population, total capital investment, agricultural capital investment, pollution, and non-renewable resources.

The mathematical model consists of a set of equations for the rate of growth or decline of each of these variables, together with a set of "look-up tables" which describe in tabular form the assumed dependence of various rates on other quantities in the model. (For example, there is a look-up table describing the way the birth rate would change if pollution levels changed, assuming that all other factors influencing the birth rate were held constant.)

The equations of the model are then solved on a computer to generate histories for the five principal variables during whatever time span is of interest, starting from appropriate values at the beginning of the time span. Typically, such runs are made for the period 1900 to 2100.

Forrester's work was subsequently extended by a research team at M.I.T. headed up by Dennis Meadows with financial support from the Volkswagen Foundation and the Club of Rome. Instead of just five basic variables, Meadows and his colleagues used eleven: three population age groups; industrial, service, and agricultural capital investments; potentially arable land, developed arable land, and urban-industrial land; pollution; and non-renewable resources. In addition, a number of the couplings or interactions were modified slightly; nonetheless, the results did not

Peter Vajk, 33, born in Hungary, is a senior physicist at the Lawrence Livermore Laboratory working with their computer system, the largest in the Free World. I am rabid enough on the population question to be glad to see some intelligent and original points made on the other side. The present major function of the Space Colonies is just that, giving perspective enough to see other sides.

–SB

show any differences, really, from Forrester's, and appeared in 1972 in the widely publicized book, *The Limits to Growth* *[EPILOG, p. 464]*.

Both of these M.I.T. models, as they are often called, project a massive collapse of the socioeconomic system and of the population in the first third or half of the next century. The primary cause of the collapse is the dwindling of non-renewable resources to such a low level that, according to the assumptions of these models, virtually all of the capital investment is tied up in extracting resources, and very little is left for manufacturing goods and providing services.

Last year I decided to see whether space colonization could significantly alter this bleak outlook. About two years ago, Dieter Tuerpe (also a physicist at Lawrence Livermore Laboratory) had extended Forrester's model into a two-sector model, recognizing that the developed countries and the underdeveloped countries cannot simply be averaged together to describe the world. With suitable modifications in the look-up tables and other constants, Tuerpe could reproduce the historical data for population growth in <u>each</u> sector for the period 1900 to 1970.

Once the premise has been accepted that the world system can be adequately modeled with only five (or eleven) basic variables, and that just exactly <u>those</u> five (or eleven) variables are the correct ones to choose, then the heart of the models is the form of the couplings or interactions. What hard evidence is available to validate the assumed couplings?

The M.I.T. models base their validation on matching the model results for population growth during the historical period 1900 to 1970 to the available data on world population for the same period. Since few countries have a regular census as does the United States, at best we have only <u>estimates</u> for the world population (or the populations of the developed and underdeveloped worlds) at 10-year intervals over that period. There are no global data for any of the other variables used in the models during that period, and one variable (pollution) isn't even defined in a way that would allow us to measure it today, let alone over the past 75 years.

So the available data, really, boil down to <u>eight data points:</u> the population figures for 1900, 1910, 1920, and so on up to 1970. Yet the Forrester model has 147 adjustable constants of which no less than 44 are used in reproducing those eight data points! (Depending on how wide a range of the look-up tables is actually encountered in a computer run for the period 1900 to 1970, more than 44 of these adjustable constants may actually be invoked to match those eight points.) In the Meadows *et al* model, there are still more adjustable constants, but only those same eight data points are available to provide validation of the entire model.

In working with Forrester's original model and with Tuerpe's two-sector model, I discovered (just as Tuerpe had) that there was a great deal of latitude available in choosing all those adjustable constants: many different sets can be found which will reproduce the historical population curve to within one or two percent. Depending on just how those constants are chosen, however, the future of the world system can be made to come out very differently.

Forrester and Meadows, for instance, found that depletion of resources was the primary cause of collapse. If changes simulating a decreased rate of consumption of natural resources beginning in 1970 were made, then a pollution crisis destroyed the world a few years later instead. If that disaster, too, were forestalled by assuming effective worldwide pollution control beginning in 1970, then the world escaped the pollution crisis but starved to death instead a few years later still. With 147 adjustable constants to pick, it is possible to choose <u>whatever</u> sequence of calamities you prefer, without ever changing the population curve up to 1970 by more than one or two percent. Moreover, it is possible to fudge the constants so as to produce <u>no</u> catastrophe, but rather continued growth, for several centuries into the future!

The feat of reproducing the eight data points by using a model having at least 44 adjustable parameters in it is, of course, just a computer-age version of the old shell game: the computer is swifter than the eye, and you only get out of the model what you put into it. As with ANY computer program, if you put garbage in, the computer very reliably gives you processed garbage out; Malthus in, Malthus out.

The values of the adjustable constants which were chosen by Forrester and by Meadows simply reflect their neo-Malthusian beliefs derived from the popular wisdom that pollution, dwindling resources, and exhaustion of farmland will pose insuperable problems in the near future. But are things really so simple, so black-and-white?

Are there, for instance, more deaths in the industrialized nations from pollution now than there were, say, a hundred years ago? Is the pollution-related death rate in the United States greater than that in India, where the degree of industrialization is certainly far lower? As far as potential for human lethality is concerned, the most dangerous pollutant is raw human sewage, which is a vector for numerous nasty diseases including cholera, typhoid, and dysentery. The annual death toll in India from these diseases is staggering, while they are virtually unkown in the United States and Europe, because the industrialized nations had the resources and technology to control sewage, and made the policy decision to do so. (China controls its sewage by composting.)

But this "fix" has introduced some subtle new problems. Polio and hepatitis can be very serious diseases for adults and older children, but are usually very mild in infants. Where sanitation is poor, most infants are exposed to these diseases and acquire lifelong immunity. But in the United States, sanitation is excellent, so that very few infants gain natural immunity. If the polio virus then crops up, the result is an epidemic among a population which has heightened susceptibility to damage by the virus.

Is there really a problem with dwindling natural resources? Technical expertise here is strongly polarized, so that the issue is far from settled, even if we neglect the possibilities of mining the oceans or importing materials from space. The "technological optimist" argues that we will always be able to find substitutes for any particular material that might become exhausted; that we have not found all the available resources of the planet; that we have not yet begun to recycle on the scale that is technologically feasible today; that as new technologies emerge, lower and lower grades (and thus larger quantities) of ores will eventually become accessable. The "neo-Malthusian" argues that a law of diminishing returns is just about to set in, so that extracting the next increment of resources at a lower grade will inevitably become more expensive.

Forrester and Meadows adopt the neo-Malthusian view on this issue, flying directly in the face of the historical trend: the overall cost per ton extracted for the United States minerals industries has declined continuously from 1870 to at least 1957, according to a study published in 1963, because of technological advances and new discoveries. (Barnett and Moore, *Scarcity and Growth*, John Hopkins University Press.)

What about the exhaustion of arable lands? The productivity of commercial farms in the United States is the envy of most agronomists around the world. The methods used to achieve these high yields, however, are very capital intensive and energy intensive, and appear to have serious adverse environmental impacts in the long run. But there are alternatives available: research by Ecology Action of the Midpeninsula (2225 El Camino Real, Palo Alto, CA 94306) on the "biodynamic/French intensive method" of farming has already shown that this method can achieve double the productivity of conventional methods, <u>without</u> intensive use of fertilizers,

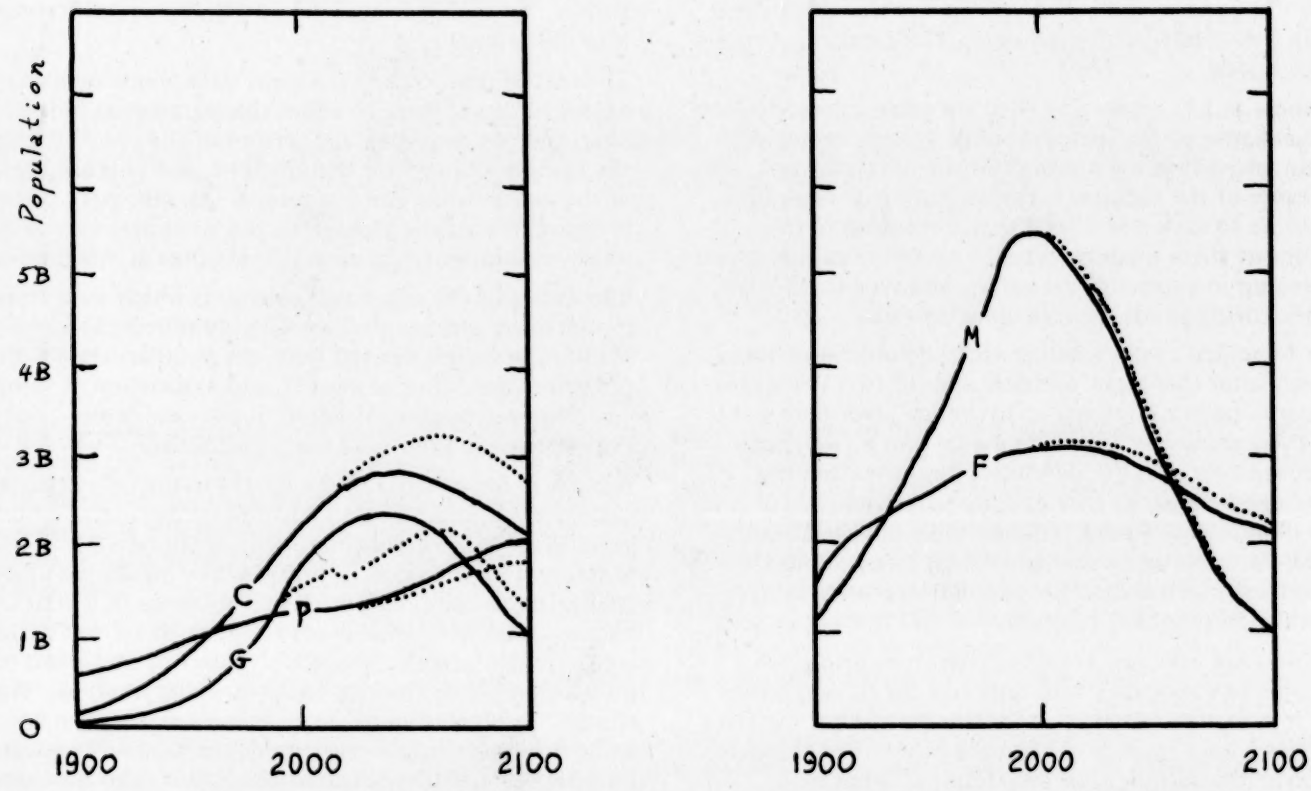


Figure 1. *Results of world dynamics calculations for the developed world. The dotted lines show the effect a space colonization program and solar power satellites might have if the program began in 1982. Population is in billions; all other scales are in relative units. P–population; C–capital investment; G–pollution; M–material standard of living; F–food per capita.*

machinery, and irrigation. Moreover, the method is moderately labor intensive and is thus readily transferable to the underdeveloped countries.

A very conservative assessment by the National Academy of Sciences suggests that we have the techniques in hand for feeding nearly 10 times the present population, even if the total arable land cannot be increased more than two-fold. (*Resources and Man*, W. H. Freeman and Co., San Francisco, 1969.) Thus malnutrition and famine are not the symptoms of our inability to produce enough food; rather they reflect inequities in distribution.

According to the popular wisdom, however, all these problems are merely symptoms of the BIG problem, population growth. The increasing numbers of humankind have thus been pejoratively described as a "bomb" or as a "cancer" on the Earth. In this view, more people make more pollution, consume more resources, need more farmland. Higher densities of people are blamed for the increased levels of violence in our cities; for the overcrowding of our national parks; for the declining quality of life throughout the land. The simplistic "solution" is immediately obvious: we must curb population growth, and the problem is so urgent that there is no time for an "ethical impact statement," and it is considered irresponsible to question whether population growth is, in fact, the real cause of our difficulties.

I recently received an appeal letter from one of the better-known organizations dedicated to reducing the worldwide rate of population growth. In it, the claim was made that the number of children abused by their own parents has increased by 1,000% in the last ten years, and that this was obviously due to excess population growth.

But an "ethical impact" analysis would have to raise this question: Is the increase in child battering, to any extent, due to the population control movement? The increased rate of child battering has, in fact, kept step with the decreased birth rate since the 1950's.

In America, parenthood is now a very difficult occupation. When a parent who is just managing to cope with the stresses of inflation, recession, and future shock has to handle an infant or toddler who is not a full-time bundle of joy, and that parent is then made to feel guilty for having produced the child, then maybe it is no surprise that today more parents are crossing the ragged edge of control and turning to violence against their own children.

When carefully analyzed, it seems that virtually all the problems which are blamed on population growth are, fundamentally, the results of society putting its priorities in the wrong order. We are willing, collectively, to spend huge sums of money for vacation travel expenses and for recreational vehicles, but we are unwilling to allocate tax moneys for the acquisition and development of new national parks, and new county parks. We are willing to provide millions of dollars of municipal and federal funds to refurbish municipally owned airport terminal buildings, but we cannot find the money to develop small neighborhood parks, which could often be built with volunteer labor from the neighborhood. We have shiny new cars which we drive over crumbling city streets. In brief, we have in America private affluence and public squalor, in Galbraith's phrase.

The real problem, it seems to me, is how to assure a high quality of life for everyone. A holistic view of this problem cannot be attained if we myopically focus our attention on population growth. For me, such myopia conjures up the image of the cartoon character Mr. Magoo trying to lead a recalcitrant horse across a narrow bridge after mistaking the horse's tail for the bridle.

The population control movement does sense that the quality of life is at issue, but many of its more extreme proponents end up sounding like some of the American military officers in Vietnam not so long ago. Melvin Ketchel suggests, entirely seriously, that we should develop contraceptive chemicals for dumping into the water supplies of Third World nations with high birth rates. ("Well, you see, we had to destroy their villages to save them.")

A recent Associated Press story calmly reported that the Indian government is giving increased consideration to

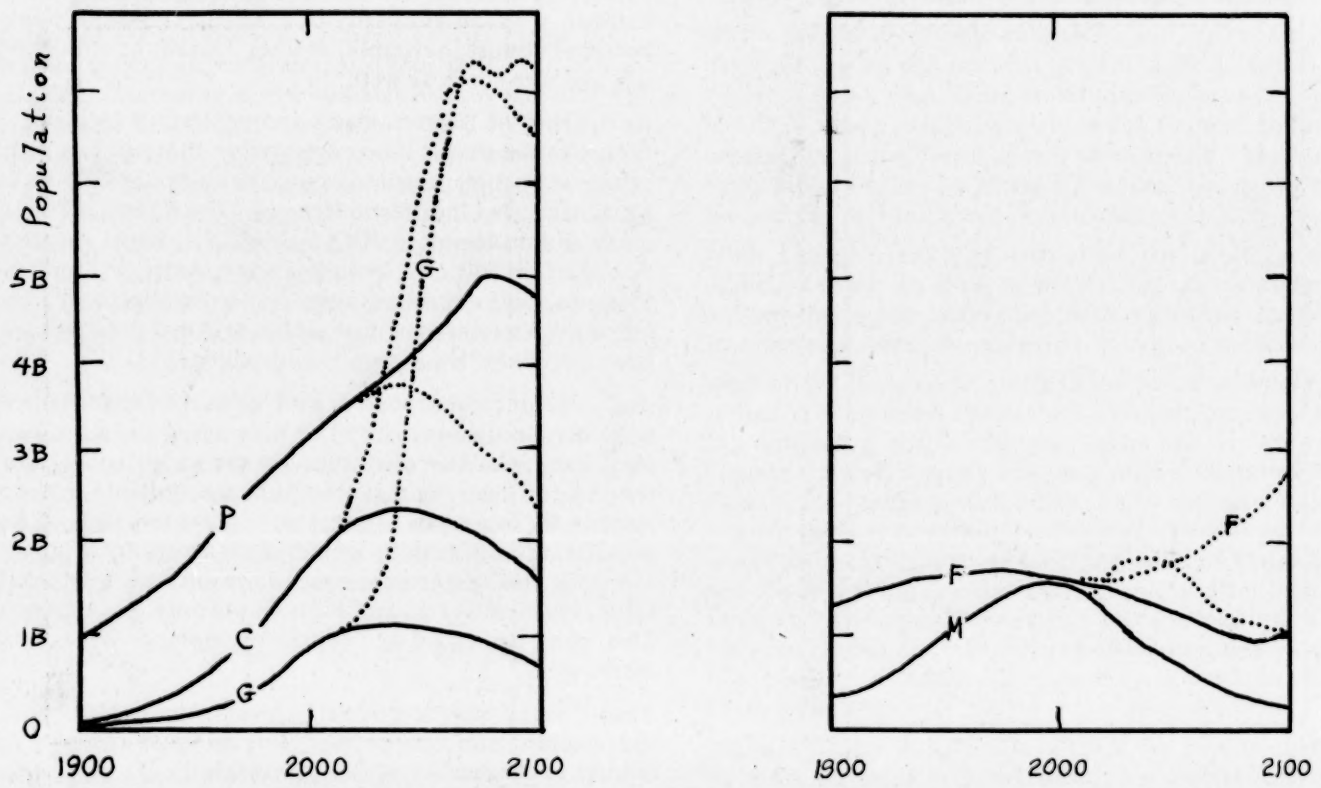


Figure 2. *Results of world dynamics calculations for the underdeveloped world. No satellite energy is delivered to the underdeveloped nations until 2007, when the project has paid for itself from energy sales in the developed world. If power were sold here earlier, the picture would improve further.*

compulsory sterilization programs. Only a bit more than a year ago, the press was justifiably up in arms when it was learned that a few mentally retarded black women on welfare in a Southern state had been sterilized without giving their informed consent to the operation.

Have we fallen so low in just a year that we are not horrified by the suggestion that perhaps a few hundred million citizens of what was the largest democracy in the world should be forcibly dragged under the knife by their own government? Or are the Indians not sufficiently human for the phrase "quality of life" to be applicable?

History has, perhaps, pardoned America's use of atomic weapons on Hiroshima and Nagasaki on the grounds that we did not at that time fully comprehend the enormity of those acts. Nonetheless, despite the multiplication beyond belief of strategic and tactical nuclear weapons by the major powers, not even the smallest tactical "nuke" has been used in three decades, despite multiple opportunities. The reason, I think, for this remarkable restraint has been the realization that once the line between conventional and nuclear weapons has been crossed, anything goes. If India or any other nation adopts compulsory sterilization as part of its national policy, a different critical line will have been crossed into a new and horrible class of violence, all in the name of "quality of life." I fear that this critical line is not seen as clearly as in the case of nuclear weapons, but the line is just as real.

Having said all this, I can now talk about the thorniest issue the space colonization concept raises. Once we have established a viable beachhead in space, the lid is OFF! Using present day technologies, and readily foreseeable technologies, colonies can be built not only from lunar materials but also out of asteroids and the moons of the outer planets. O'Neill estimates that we could thus provide new lands for more than seventy thousand billion people – a level we would reach in about ten centuries if population continued to grow at the present rate of about 2% per year.

Is it conceivable, though, that we could export enough people from the earth to stabilize the population down here? Assume, for the sake of discussion, that the population of the earth 50 years from now is 10 billion people, and suppose that the rate of population growth is still 2%. That means that population stabilization on the earth would require the emigration to new lands in space of 200,000,000 people annually. Isn't that preposterous?

To put that question in perspective, think back 50 years. At that time, the number of people who had crossed the Atlantic ocean by air was less than the number of people who have today been in space. Today we take it for granted that the airline industry in the United States alone carries 200,000,000 passengers every year. Okay, but is a jetliner in any way comparable to the space shuttle or an Apollo flight? The energy required to launch one pound into earth orbit is, in fact, the same as the energy needed to ship that pound from San Francisco to New York by airfreight. The difference is simply that the jetliner spends five hours burning up that much energy, while a rocket burns it up in less than five minutes. Both vehicles are built by the same industries using the same technologies, and the price tag for one Boeing 747 is not enormously different from the price tag that Saturn rockets would have if they were built in the same quantities as 747's. The advance from an Apollo capsule for three people to a re-usable launch vehicle carrying 1000 passengers is less difficult than the advance that has been made in aircraft between the Wright brothers' one-man ship and the 747 with more than 300 passengers and crew. It is possible to design and build such launch vehicles to have less environmental impact than our present airline fleet.

Some population control advocates immediately cry out in objection, "What's the point of making it possible for humanity to breed so prolifically? What is the value of increasing our numbers 20,000 fold? Do we have any right to go on filling up the universe with ourselves and our progeny?"

These objections, carefully analyzed, are based, first, on a mental model of ecological systems in a closed environment and, second, on an unconscious denigration of the value of each single human life.

[more →]

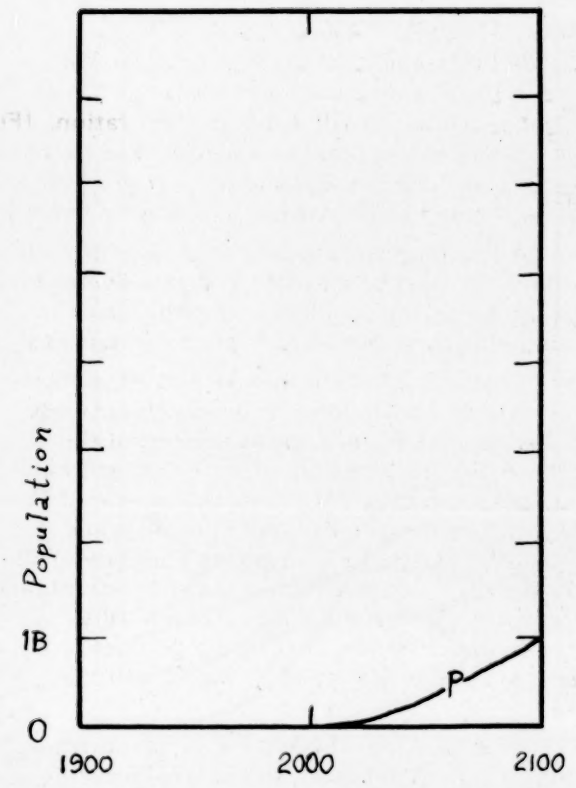


Figure 3. *Population growth in the space colonies. Migration from earth is a major factor in the growth rate, although the migration rates used here were significantly lower than for the departure of people from Ireland over the period 1850 to 1930.*

In a closed ecological system, there is for any particular set of species a maximum carrying capacity for each species. But if the system is enlarged, the whole system can undergo both quantitative and qualitative transformations. In the primordial seas of earth, simple molecules such as carbon dioxide, nitrogen, methane, and ammonia were processed into amino acids and progressively more complex organic molecules by ultraviolet light and lightning until life appeared. The primitive life forms metabolized these organic materials back to the simple molecules, so that the entire planet's carrying capacity for life depended on how fast lightning and ultraviolet light could re-synthesize the organic nutrients.

The total biomass on the planet was very small, and remained tightly constrained until some ingenious life form in those primeval seas managed to reach outside the system, obtaining access to external resources. The "invention" of photosynthesis allowed life to vastly increase the rate of conversion of simple molecules into useful nutrients. The carrying capacity of the planet was enlarged, and a rapid population expansion forever changed the face of the Earth: Gaia had been born and began to reshape the physical environment to suit her own needs, without asking whether she had the right to fill the universe with her progeny. (See Margulis and Lovelock, "The Gaia Hypothesis," *CQ*, Summer 1975.)

Krafft Ehricke observes that one of Gaia's offspring is on the verge of reaching outside the system as before; it is entirely natural, from this point of view, that mankind should thus extend the biosphere off the surface of the home planet, thereby increasing the survival chances of the species and of Gaia as a whole. ("The Extraterrestrial Imperative," *Bulletin of Atomic Scientists*, November, 1971.)

"What's the point, what's the value?" The answers implied by those who ask these rhetorical questions are that there is no point, there is no value to that large a number of people — or, indeed, to any other number of people. Doesn't that imply that there is no value to an individual human life? That evolution blundered, and *Homo sapiens* ought never to have emerged? Doesn't such a view reveal a sense of self-hatred? If so, an antipathy to bearing children of one's own becomes almost inevitable, as does a latent hostility to anyone else's children as well.

At the root of Western man's *anomie* lies his frequent failure to see that it is not population that matters or has value, but people, a point expressed so beautifully in E.F. Schumacher's Lindisfarne lecture, "The difference between unity and uniformity" (CQ, Fall 1975). Many people from non-Western cultures, including some American Indians and Eskimos, have expressed a sense of frustration and anger when asked by Americans or Europeans or Australians whom they have just met, "How large is your village?"

The value or the purpose of each person's existence is fundamentally a religious matter, which each of us has to resolve personally, to "save our souls," in the shorthand of Christian theology. Given the resources that are available in the solar system, for any of us to place an "optimum size" on the population of humanity would be an arrogant intrusion on everyone else's right (and need) to resolve his own personal value, his own worth, and his own purpose of existence. This, perhaps, would be the greatest violence yet against men's souls.

Thus the key question in an "ethical impact statement" on space colonization becomes, "How do space colonies contribute to the quality of life of mankind?"

The first benefit of space colonization could come about during the 1980's, even before the first colony is complete. Since the projected costs are low enough that the United States, the Soviet Union, the European Common Market, Japan, or OPEC could each afford the entire project alone, it is most likely that they would all undertake space colonization as a joint effort in an international consortium. Other nations would very likely join as minor partners. International cooperation on a scale of this magnitude would tend to relax international tensions, especially since it would clearly be enlarging the resources base for everyone.

The first material benefit bearing on the quality of life is the cheap, abundant, non-polluting, non-depletable energy the space colonies would provide via solar power satellites built by the colonies out of non-terrestrial raw materials. Sunlight would be converted into microwave energy, beamed down to receiver antennas on earth, and converted back into cheap electricity. This would allow the United States and Canada to avoid massive deployment of nuclear power plants and to avoid strip-mining vast areas of the Western states in the 1990's. By about 2010, all nuclear and fossil fuel powerplants could be phased out.

Most "fixed base" uses of energy in our homes, offices, shops, and factories could be shifted over from fossil fuels to satellite solar electricity during the next two or three decades. By that time, the electricity would have become so much cheaper than fossil fuels that it would be economically advantageous to shift transportation from fossil fuels to synthetic fuels derived from air, water, and renewable biomass sources with the aid of electricity.

In North America, it is easy to say, "Sure, that would work; but we wouldn't need all that energy if we would only conserve more." But that approach denies the need of the rest of the world for energy. A study released last fall on the "firewood crisis" documented the massive ecological damage in the Third World due to their energy impoverishment, where firewood has been the traditional energy source for heating and cooking. (E.P. Eckholm, "The Firewood Crisis," *Natural History*, October 1975.) In the 1950's and 1960's, kerosene and other liquid fuels were making major inroads into firewood consumption, much to the relief of foresters throughout the world. But the OPEC price rises have completely reversed that trend, so that many of these areas are becoming rapidly denuded of trees and shrubs.

Deforestation of the Sub-Sahara has been a major factor in the southward spread of the desert, and thus in the famines of recent years. Denuding of the Himalayan foothills has resulted in greater flooding of the plains below, wreaking massive damage on crops in Pakistan, India, and parts of Bangladesh. The Nepalese villager is unaware of the damage he causes in India, but even if he knew about it, what choice would he have? His bare-bones energy consumption amounts to about a ton of firewood per person per year just for cooking. The lack of alternatives has fostered the widespread use in recent years of dried cattle dung for fuel, irreversibly removing the nutrients and humus from the soil. The soil fertility is decreased, and its susceptibility to erosion is increased.

Liquid fuel synthesis based on satellite solar electricity can stop this violence against the land and help to heal it. No other energy technology presently foreseen can do this job. Without a substitute for wood and dung, nothing can save most of the Indian subcontinent from becoming a devastated moonscape unfit for man or beast, and "quality of life" will be a bad joke.

In Gandhi's words, "To the poor, God dare not appear except in the form of food and jobs." Without massive infusions of cheap, clean energy, grinding poverty is the relentless prospect for much of the Third World. Satellite solar energy could be the key to realistic new hopes for improvements in the quality of life.

Are there no drawbacks to abundant, cheap energy for the Third World? If massive and rapid Western-style industrialization were to follow, we could expect major disruptions in family structure and in the social patterns of village life. Abundant liquid fuels synthesized from satellite solar electricity, however, would facilitate instead the widespread use of Schumacher's "intermediate technology, and minimize disruptions in the existing social order.

For the sake of discussion, I went through the exercise of running a two-sector world dynamics model to see what effect the energy alone might have. Based on considerations such as I have just discussed, I developed a model for the coupling between increased energy supply and economic growth. Substitution of solar energy for fossil fuels, of course, reduces the demand for non-renewable resources, and also reduces pollution generation by a similar amount. A moderate level of emigration was also allowed, peaking at about 10,000,000 per year in about 2030. Construction of new colonies was assumed to be restricted by the costs of transporting colonists, nitrogen, and hydrogen from the earth at 1980's launch costs, despite the fact that those critical materials will certainly be obtained far cheaper from the asteroid belt fairly early in the game, and launch costs for new colonists can be expected to decrease substantially.

The results for the developed and underdeveloped worlds are shown in Figures 1 and 2, respectively. The solid lines show the world dynamics projection if we do not colonize space; the dashed lines show the projections based on the above conservative assumptions if space colonization begins at full speed in 1982. The principal effect satellite solar power has on the developed world is to somewhat reduce pollution. The effect on the underdeveloped world, however, is quite dramatic. Economic growth rapidly raises the material standard of living, which lowers the birth rate enough to reverse population growth much earlier and at a much lower level than would otherwise be the case. Emigration, too, helps halt the population growth, but is a much smaller effect than the decrease in birth rate. Pollution grows to high levels, but this is because I am still using Forrester's assumptions about pollution and about Western-style industrialization. The improvements in the environment due to reversing deforestation have not been included.

In these figures, the world system still undergoes a decline in the latter part of the next century, because natural resources on the earth still become exhausted, and the model has not included the benefits of mining the asteroids. Figure 3 shows population growth in the space colonies. Most of the exponential growth is due to immigration. (Full details of the model will appear in an article "The Impact of Space Colonization on World Dynamics" later this year in the journal *Technological Forecasting and Social Change*.)

While I have serious misgivings about the validity of such models, I think the exercise shows that space colonies are not antithetical to halting population growth: space colonies can, in fact, enable that to happen spontaneously.

What about the quality of life in the space colonies themselves? The physical constraints on possible designs result in a number of positive features in the lifestyle of the colonists. First, the physical scale of the colonies is much more human than in most cities. Early colonies would be small enough that walking, roller-skating or bicycling would be totally adequate for transportation inside. Without the automobile, it is a much safer world for infants and toddlers, permitting a return to a more communally-oriented family life. (In most of the United States today, a housewife with toddlers is trapped by the ubiquitous automobile.)

While the colonies have lots of room for people, there is no room for garbage or pollution, so universal recycling would be "built in" from the start. Neither is there room for the accumulation of large quantities of consumer junk per capita. The result would thus be a lifestyle of elegant frugality. Clothing, furniture, utensils and everything else would be designed and built for longevity and durability. Since no-one would want to be surrounded by tawdry goods that last a lifetime, the emphasis on elegance and esthetics would bring about a resurgence in craftsmanship. Imagine the new environment of the colonies generating new forms of art, sports and recreation — the opportunities for personal creativity and fulfillment would be high.

If the experience of the astronauts is any guide, a true change of consciousness can be expected in the colonists from their voyage of emigration with its new perspective on the home planet. (See astronaut Russell Schweickart's description of his almost transcendental experience, *CQ*, Summer 1975.) It is astonishing that all of the astronauts who have flown space missions have had this kind of change in attitude, despite their hard-technology, nuts-and-bolts background and personality. So there could well be an enhanced recognition in the colonists of the unity of Earth, and a new sense of reverence for life.

The colonies could have more to offer the industrialized world than merely a way out of the energy/resources bind. Historically, we have always imitated the fashions and behavior patterns of the most dynamic society of the era. The habits of universal recycling, of elegant frugality and of treating the ecology gently will be absolutely necessary for the survival of the colonies. We might expect that these habits will be imitated on Earth, if only as a matter of style. And if these patterns of behavior could once become widespread, then I think many will find them so natural and so comfortable that they will not easily abandon them.

The colonization of space, it seems, would enable the poor nations to produce more, and would show the rich nations how to want less, with a better quality of life for everyone. ■

Books I would recommend for clear discussion of the less-popular other side of the "limits" debate:

H.S.D. Cole, C. Freeman, M. Jahoda, and K.L.R. Pavitt, eds., **Models of Doom: A Critique of The Limits to Growth**, Universe Books, New York, 1973.

H.M. Bahr, B.A. Chadwick, and D.L. Thomas, eds., **Population, Resources, and the Future: Non-Malthusian Perspectives**, Brigham Young University Press, Provo, Utah, 1972.

Space colonies should keep away from the government for a while.

ASTRONAUT RUSSELL SCHWEICKART ON THE PHONE

Russell Schweickart: I haven't met O'Neill myself, but there are hardly any visionaries left in the system right now, and it's absolutely delightful to find somebody outside the system who's got that kind of vision. The kind of people who are being attracted to O'Neill is the most refreshing thing I've seen in a long while.

The problem is that NASA is part of the system, and new ideas, at least a lot of the better ones, come from outside, and then get co-opted. If I've got a fear about this thing, it is that the system will co-opt it too soon.

Stewart Brand: How might that work?

Schweickart: Well, it might work by NASA starting to seriously fund the whole project, which unfortunately a lot of people would see as a good thing. I would see it, depending upon when it happened, as either good or bad. The later it happens the better.

SB: Why?

Schweickart: Because, if the whole thing starts getting formalized and funded by the government, then the government puts its heavy hand in it in controlling further funding, and once people get used to being paid for their time and their energies, then they're no longer going to do without it, and then OMB and the Congress, and other people . . .

SB: What's OMB?

Most of us consumers who are demeaned by mechanical conveniences never see what it is to fine-tune oneself to the edges of possibility of a superb machine.

Tom Wolfe, bless him, is chronicling that unfashionable esthetic in his slow-coming book on the astronauts, **The Right Stuff**. *Judging by Russell Schweickart, the only astronaut I've met, the men are cream by any standard. When the Space Program is moving (it's slow right now, by Nixon decree), they are athletes in a game that changes as fast as equipment design and their abilities can co-evolve. Help invent a bird and fly it and invent again. The trick is, making only mistakes they have a chance to learn from.*

The adversary is appalling distances, vacuum, radiation, and cold just three degrees above absolute zero. The ocean of space has no other side, only other tiny islands.

We were wrong in perceiving the astronauts as crew-cut robots. This interview – accidental really – may show why. And environmentalists who dump on the U.S. Space Program may have a clearer idea why environmentalist Jacques Cousteau at 64 is hanging around NASA, hoping to fly in space.

–SB

Schweickart: The Office of Managment and Budget, the old Bureau of the Budget. They're amazing. They have the lowest profile in government, and tremendous power.

They're not bad people, but their principal responsibility is to control the budget, which means mainly hold it down. The place where they cannot hold things down is where you have a constituency, where people's immediate well-being, livelihood, jobs, are affected by it. But any idea like O'Neill's, which is visionary, which is further out, which is long-term, is just a sitting duck for OMB, because it isn't going to lose anybody any votes. They can come out against it, and the President isn't going to be faced with a large constituency of people with a vested interest who are going to go after them.

As soon as something like this gets into the system formally in a full-blown way, then it goes through all of the necessities which it has to go through eventually, but if it goes through them too soon without the correct mental set in the country, without the momentum behind it and the emotional commitment to it, then things like cost-benefit analyses and the various trade-off studies and this, that, and the other thing that have to go on inevitably will kill it. The government does things when it has to, and if it picks up an idea like this too soon, it can kill it in a way which would make it difficult for somebody on the outside to pick up again.

Whereas, in its present state it was generated totally outside the government. . . . It's picking up a lot of momentum on its own outside the government, through things like CQ and others, and the government is having to respond to it because of the pressure from outside. So I'm not in any rush to see the concept come totally into the government. I would like it to be discussed in the media, at universities and college campuses and groups forming all over the country to support it, that kind of thing. If there's a little resistance by the government, it's going to pick up a lot more popular support.

SB: What do you think would be an optimum schedule?

Schweickart: I don't think it is so much time, Stewart, as it is circumstance. First of all I think we've got to reach the bottom of this cycle we're in now in the nation. We've got to see a more favorable economic attitude that can tolerate a little bit of luxury and long-range thinking. Nothing gets approved right now in the government unless you can show immediate utility.

There are only two things that get approved. Let me take NASA as an example. First are the kinds of things I'm working on right now, the earth resources satellites, the direct-payoff applications of space. You'll get support for something which shows that the nation will benefit ten dollars for every one that we invest. The other kind of project that NASA has that will get approved are those kinds of science programs which are moderate sized. Moderate sized for us

NASA

June 1968, Houston. Schweickart at a simulated altitude of 200,000 feet testing the Portable Life Support System which makes his suit an independent space vehicle. With it he made the first spacewalk without an umbilical.

is a few hundred million dollars. Programs like the Viking mission to Mars for example, which doesn't have an immediate practical value but which is legitimate science. They'll get approved because they don't make any difference, and they can be cut off immediately without the governors of half of the states and half of the Congressmen coming down on OMB or the President or somebody for cutting it off. So we do science at a level which will keep us doing science, not aggressively, but we will keep our hands in it, and we will also do those kinds of things which show an immediate benefit.

But a large-scale project like this which does not show immediate benefits, something like the Apollo program, is not going to be approved for a while yet. Now if the space shuttle works, if we get that off the ground and it works right, and the demand on its use begins picking up, there's one other thing that's got to happen. I think we're talking perhaps early-to-mid-80's before we're going to have a real test of the space shuttle. People are going to have to look at it and say, "Sure, of course we need it. How could we have ever thought we wouldn't need it," before they are going to start looking seriously at another large space project.

Now this trend towards utilitarianism I mentioned is even evident in the work that NASA is doing on O'Neill's concept, in that NASA has pushed it quite a bit towards the idea of power generation, to relay power back to earth. One of the principal reasons for doing that is because the project now takes on a practical value.

Well, that's ok, but you've got to be careful, because if you once start playing that ball game, then you've got to come out a winner within the rules of that ball game, or else you're doomed. You're much better off refusing to play until you know you can win.

The fact of the matter is that each step along the way to a lunar base or O'Neill's concept or a trip to Saturn or whatever, each step along the way is going to justify itself on practical grounds, but it will also, as a spin-off, permit the next step. The big difference is that if you have that long-term vision that O'Neill has inspired, it will generate the enthusiasm for the intermediate steps, which will then each and of themselves justify themselves on relatively mundane grounds.

SB: What are some of the intermediate steps?

Schweickart: The space shuttle is one.

SB: Once the shuttle is up what does it do that makes everybody glad it's there?

Schweickart: All kinds of things. It puts up useful satellites, communications satellites, at reduced cost. You can put up earth-orbiting earth-resources packages, which are going to help in things like city-planning and forestry management, and agriculture and all kinds of things. The shuttle is going to open up space for low-cost utilization. It's really a transportation system into a useful environment which we haven't been able to afford in a major way up to this point.

SB: Will there be any manufacturing facilities?

Schweickart: Oh yeah. Space manufacturing is a little research-y right now compared with other applications, but it's a comer. One of the nice things about space-processing

is that it's going to require man to actually be in space operating things in order to develop the technology, as opposed to things like remote sensing where you really do most of the development on the ground, put up a sensor, and let it go.

SB: Do you feel it's always better to have someone with the device?

Schweickart: It depends on what you're going to do. In the research phase, I think for complex operations the answer is yes. In the operational phase, where you already know exactly what measurements you want to make, you want to make them on a repetitive basis, you want to make them routinely, no, don't put a man up there. You can automate that. But in the research phase, it looks as though man will be very useful in space. The interesting question is whether man will be of real value in space applications in operational situations as opposed to research and development situations. That's a question people don't have anywhere near as clear a feeling on one way or the other.

The next step beyond the shuttle I think is going to be a space station in near-earth orbit, and that again I think will argue for itself partly as an outgrowth of things like space-processing. There are other reasons for going toward a space-station where you'd have a permanent crew, or at least a crew which you would cycle just occasionally.

September 1975, Bahamas. Schweickart at the helm of Jacques Cousteau's research ship Calypso. *They were comparing satellite and surface oceanographic data – Landsat overhead, divers below.*

SB: A crew of what size, do you suppose?

Schweickart: Oh, it'll probably start out modular, and build. Ten people to start with, and then you'd probably build up to stations which would have hundreds I'm sure. But that's a long way off.

SB: How thick are the Russians in that stage of the fantasy?

Schweickart: Well, you never know. They seem to have a lot more fantasies than we do. That is, they seem to be more willing to speculate and wave their arms about things of that kind than we are. It's questionable whether they have the real competence or the real determination when it comes to putting the ruble down to do it. There's no question that our technology is way out in front of them in most of the things we're talking about, in anything that requires sophistication, in the practical use of space, but when it comes to speculating about it and talking about far-out things, the Russians are more willing to do it than we are. Perhaps because they are further away from having to commit real resources.

SB: Do you know of any interest by them in the O'Neill concept?

Schweickart: As a matter of fact I don't. I have no knowledge of whether they've been looking at it, or even whether they're familiar with it.

SB: I've heard speculation that the Russians and we have some kind of unstated mutual program, that we seem to be making vehicles like mad, and the Russians seem to be more into pay-load like mad. For a space station or whatever. Is that the case?

Schweickart: No. Well, I can't state positively that I know it's not the case, but I'm high enough in the organization that I know we're not that cooperative with the Russians yet that we would forsake one element to them and risk getting caught with vehicles and no payload, or vice versa. We're a long way from that. Even with the Europeans where we're in an arrangement for the shuttle/space lab, even there our shuttle can do a lot of things without their space lab, but the space lab can't do anything without the shuttle. So we're on the safe end of the deal.

SB: There's a European consortium?

Schweickart: Yeah, the European Space Agency – ESA – which is a combination of ESRO, the old European Space Research Organization, and ELDO, the European Launch Development Organization. It's a consortium of something like 12 European nations which collaborate on a project-by-project basis. They're all members but they can opt whether or not to participate in any given project. With the Spacelab I think all 12 of the members are partners, with the Germans being the leading interest.

SB: Is that a growing involvement by ESA?

Schweickart: It's a total commitment. They have sole responsibility for the design, development, manufacture and testing, and everything, of the spacelab which will fly in the shuttle. NASA is basically a customer. We actually will purchase our spacelabs from Europe, so we are really totally dependent on them for that concept. On the other hand, what they did in doing that was to give up an autonomous space program, because they scrapped all of their major development in terms of boosters for independent pay-loads. They really hung it out.

SB: What level of budget are they into with that?

Schweickart: I'd have to do a little research to tell you. It's something I'm not directly connected with, so I don't know those kinds of numbers. Off the top of my head it comes to something like 500 million dollars. It's big.

SB: What are prospects of a Concorde-type debacle out of that do you suppose?

NASA

March 1969, Earth-orbit, Apollo 9. Schweickart, pilot of the Lunar Module "Spider", goes outside to get a thermal sample. More "outside" than anyone had ever been. With him on the mission were James McDivitt and David Scott, who took the photograph.

Schweickart: I think very very low. There's a mutual inter-dependence here which is an interesting thing to watch. Europe, because of its commitment now, has put a certain pressure on the United States to continue the program, and to stay on schedule, and not rock the boat, because of our partnership. At the same time Europe is somewhat the same way. Because the shuttle is going on, it's overcoming a lot of their political problems to keep the thing together. The inter-relationship obviously will have rough spots. When you marry somebody it's a little different from living with them. Things bother you that didn't bother you before, but at the same time you have a committed relationship, and the children will come.

SB: Do you know if ESA has any knowledge or interest in space colonies?

Schweickart: Yes, they do. But I don't know how formal it is, and I don't know what their specific reaction to O'Neill's thing is, but I do know that they have looked at long-term projects. In about '81 the first operational shuttle will carry the first spacelab. It'll be a cooperative European-American payload.

SB: Are there any Europeans in the astronaut program yet?

Schweickart: There are no Europeans in the astronaut program right now. The next selection however is being considered now, I think for a year from this summer if I remember right, and I'll be very surprised if we don't find European applications, and probably we'll be accepting some Europeans. Now, that's a delicate matter. NASA may ask ESA to recommend specific people rather than the United States trying to select among the member nations of ESA. Imagine the delicacy of that one. You can see Spain, with a 3% budgetary commitment, in the spacelab with an astronaut and Germany with 53% commitment having none, or something.

SB: Is the space shuttle very adaptable to moving from near-Earth orbit to lunar-distance orbit, for work on Space Colonies?

Schweickart: Not directly.

SB: How serious a change would be required?

Schweickart: It would require a total new vehicle. The shuttle is really designed to do one job and one job only, and that is to get into low-earth orbit from the surface and back down to the surface, and do it over and over again. That's where you realize the economies. But even if you severely penalize the payload and put in the maximum number of additional fuel modules and things, you're limited to something like a 600 mile high orbit, which is not very high. The normal orbit would be a hundred miles or so. Well, that's a long, long, long way from going out to lunar distance and returning.

SB: Is fuel the limitation?

Schweickart: Well, it's two things. It's fuel, but also there's no reason for taking wings to the moon. The only reason to have wings is to mess around in an atmosphere.

SB: Would you end up with a two-stage shuttle — the shuttle-shuttle to get to near-earth distance, and something else to get to lunar orbit?

Schweickart: Right, you would have a vehicle which would have to be designed probably to be carried up either whole in the shuttle, in the payload bay, or more likely be carried up in modular form and assembled in orbit perhaps near a space station, and then go from there to the moon, and back again. You end up with basically a stable of different vehicles for different purposes. You would have a vehicle which would provide transportation to lunar orbit from earth orbit. You would probably have another vehicle which would go from lunar orbit down to the surface.

SB: Would you use the same vehicle to get to O'Neill's colonies at L-4 or L-5 as you would to get to lunar orbit?

Schweickart: Yeah, no reason that you couldn't. Once it's been built, that vehicle is going to serve all its life in a weightless state. It could take you anywhere. But if you're going to come down through an atmosphere, whether it's a Jovian atmosphere, or Earth atmosphere, or Martian atmosphere, or

wherever there is a problem in aerodynamics, you need another vehicle.

SB: How's the space environment for maintenance on a piece of equipment like that? Is it going to be worn out in a number of years, or go on indefinitely because it's operating in a weightless vacuum?

Schweickart: Well, we don't understand all we might about that.

SB: Presumably the stresses are mainly in the propulsion system.

Schweickart: Not entirely. We don't understand rotating equipment, for example. Bearings. In some sense bearings ought to last indefinitely in space. You don't have any gravitational forces wearing them out. All they do is sit there with just occasional very very small stresses on them. In fact that's not the case. We had large rotating inertia wheels on Skylab which were the principle means by which we changed the attitude, or controlled the attitude of the laboratory. And one of them failed. I think it was at the end of the second mission, or maybe the beginning of the third mission, and a second one was having heart attacks and was threatening to fail as we approached the end of the third Skylab mission. Now, these momentum wheels are monstrous, they're just huge fly-wheels is what they are — not all that huge, only about a yard across, but they're pretty massive, and they spin at 10,000 rpm or something like that, very fast. You've got a lot of momentum in them, and you do generate side forces on the bearings, but we don't understand the failure mode. We don't understand why they failed or how they failed. There are different ideas about lubrication in weightlessness, and how the flow of lubricants and the behavior of surface tension effects in liquids is changed in weightlessness, so we don't really understand it fully. There are some pretty interesting engineering questions that have to be answered before you are going to be able to really design things in detail like Gerry's space colonies.

NASA

Skylab 3, 1973.

SB: Are there any problems like that with the centrifugal gravity that O'Neill is counting on?

Schweickart: Artificial gravity does do some nasty things. The only way to generate an artificial gravity, of course, is to rotate, and when you rotate you immediately complicate the process of looking outward from the spacecraft. If you want to look internally and work internally, it's no problem. However, if you want to communicate with the earth, or you want to point a radiotelescope, or an optical telescope, or you want to make observations externally, then the only direction you can look is along the axis. And even then unless you want to have things rotate as you look at them, you immediately have to de-rotate something. You've got to somehow get out of the rotating system, or counteract the rotation by having a counter-rotating hub, or perhaps some sort of separate equipment standing off to the side that doesn't rotate and a data link between you and it or something of that kind, so it complicates and therefore increases the cost of space operations to have an artificial gravity.

On the other hand there are obviously very nice things about having an artificial gravity, in that things behave "normally" and you don't have to take all the precautions with containing liquids. Convection works, as well as a lot of other things that you are used to here on earth. And if you're going to start growing food and vegetables and things, there's a lot less uncertainty about what you're trying to do if you have an artificial gravity. On the other hand, the work with Skylab was all in zero gravity. We had three guys up there on the last mission for about three months. After 84 days we saw no indication of anything that would stop us from going for significantly longer periods.

SB: How was it for them when they got back in 1-g?

Schweickart: Well, it was better for them than it was for the guys who stayed up a shorter time. They were in better condition than the crew who stayed up for 59 days, and they in turn were in better condition than the crew that stayed up for 28 days.

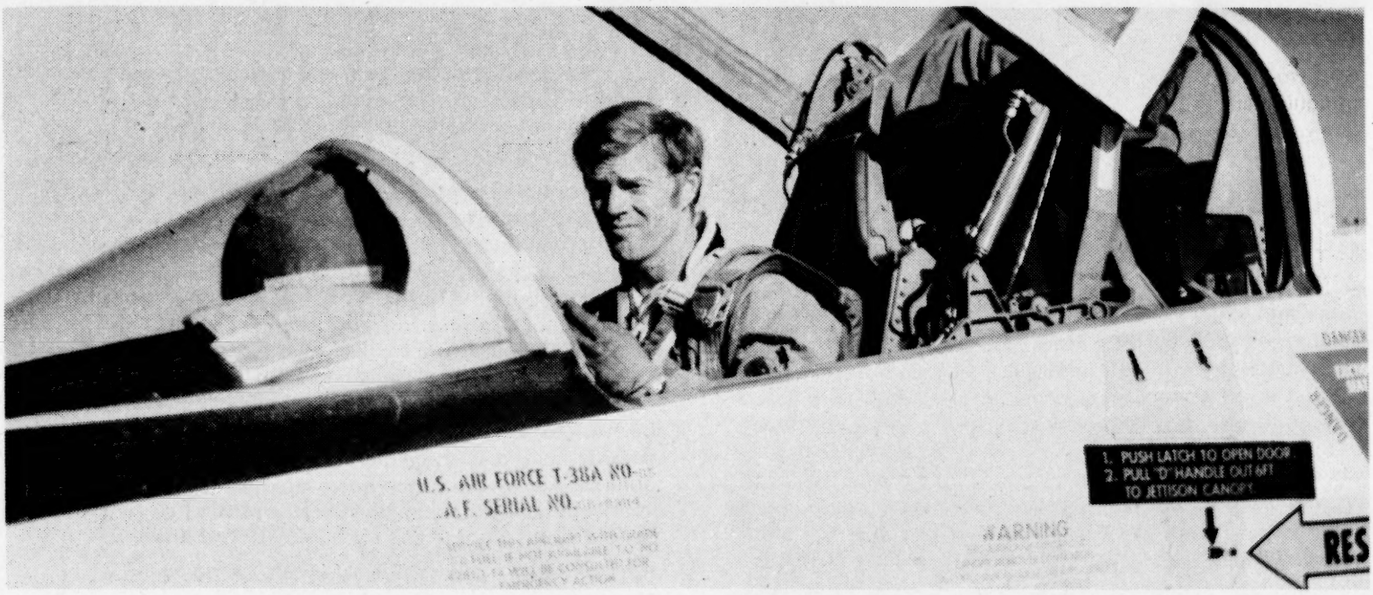
SB: Any explanation?

Schweickart: Yeah, there are two. One is that going from the shorter to the longer flights we increased the amount of exercise in each mission. We started out with a little over a half an hour per man per day. The second mission we went to about an hour per man per day. The third mission we went to about an hour and a half per man per day.

SB: This is just thrashing around in mid-air or playing with ropes or what?

Schweickart: Oh no. This is programmed physical exercise. Either riding a bicycle ergometer or running in place against a set of bungies on a teflon sheet, or arm exercises with a bungie, or various exercise devices we had. And putting out real work. Not just keeping limber but really putting out a hell of a lot of BTU's. As you do on earth, everybody felt subjectively much better after the exercise. They felt more invigorated, more energetic, more wide-awake, all the same things, except I guess you might say in spades compared with here on earth, because we put out a lot of work just sitting. In weightlessness, everything is floating, and you really power down. Your muscles are doing nothing. Here on earth just reacting against gravity, sitting up in a chair, walking around, getting the coffee, is a lot of work that you just take for granted.

The other reason is that we found that you reach in some sense a low point in the adaptation process somewhere around 21 days. If you look at all of the various physiological parameters — heart rate versus work, oxygen uptake, red blood cell count, heart rate and electrocardiogram under various stress conditions, they all have a different time history in their adaptation. But you could say that at some-



1970, some airfield or other. To maintain astronaut status Schweickart regularly flies a NASA T-38 high-performance jet. Meantime, with the Space Program slow-down, he flies a desk at Washington NASA Headquarters as Director of User Affairs, Office of Applications.

thing like 21 days you kind of reach a low point, and then begin returning to basically a pre-flight condition. Gerry Carr on the third mission actually came back at about the same weight he launched at. Body weight is a good indicator. It decreases and then goes back up. Subjectively you bottom out in about a day or two with space sickness, and then start coming back.

SB: Was that your experience?

Schweickart: I put my own reactions off by not moving around for about two days, so I had about a day to two day lag in there which I found out afterwards is not the right thing to do, but we didn't know it at the time. Basically you find that you physically feel the worst after about a day or two, and then from there on you feel a lot better. That's quite noticeable. But the things which you aren't aware of continue on this trend for several days, or in some cases weeks, and then start coming back up again.

SB: What's the effect on dreaming?

Schweickart: None that we know of. We measured the sleep in Skylab and the basic observations are that not only do you end up getting about the same amount of sleep but the same proportion of sleep is spent at the different stages and in REM sleep.

SB: How about dream content?

Schweickart: I don't think anybody ever consciously tried to do any analysis of dream content. Most of the guys aren't the kind of people who even recall their dreams on earth let alone up there, and nobody seriously proposed trying to train anyone to recollect their dreams or wake them up during REM sleep or something like that to recount dreams.

SB: Did you have anything?

Schweickart: No. I'm not even aware that I dreamt at all, but that's true here on earth too.

SB: Let me get back to grand strategy for a minute. I've found that a lot of people who don't like space colonies because it will take money from other things get real interested if they think that space colonies might take money from the Department of Defense. That's a trade-off they'll accept. Do you see any practicality in that?

Schweickart: I don't know. That's so wrapped up in the nature of man, Stewart. It's difficult. That's the dream of an awful lot of people. It's certainly mine. A lot of people have written statements or comments about that as a concept. I just don't see any . . . Angola is a great example. We just had one of the worst lessons in our life in Viet Nam, and yet here we are in Angola messing around, and it's only the Congress yelling and screaming which has forced the Administration to back out of it. This system is so oriented and conditioned to the idea of having to protect itself from other nation states that I'm not optimistic. I wish I could be.

SB: At least the Congress is resisting this time. They didn't before.

Schweickart: Yeah, I think they've gotten the message a little bit better maybe than the CIA and other people. I don't think that Congress is any smarter or any better intentioned than anybody else. The real difference is that Congress is accountable and the CIA is not accountable. The Administration is every four years, but even then it's not as accountable as the Congress is, and that's really the major difference. The people of the country have learned a lesson in Viet Nam, and they're gonna ensure that Congress knows it. The CIA and all the rest of DOD, the whole government (NASA included, NASA's no different, it's only that we're not responsible for national security) – if you don't have direct accountability you're going to keep going in the way that your momentum vector is pointed, and that is what we've been doing for a couple hundred years come July.

SB: NASA's not as subject to that as CIA or DOD I guess.

Schweickart: Not as much. But we're a bureaucracy too, there's no question of that. I'm not starry-eyed about that. I'm thankful that we've got a lot of bright people but I'm sorry that we don't have too many visionaries. I almost cried the day Von Braun left. Do you know Jesco von Puttkamer?

SB: No, who's that?

Schweickart: Jesco came from Germany but I think he's not old enough to have been associated with the original Peenemunde crowd. He went to Marshall Space Flight Center and worked for Von Braun, and he now has come to NASA

headquarters in Washington. I forget what his title is, but he's basically responsible for advanced planning in the Office of Space Flight, which used to be the Office of Manned Space Flight. He's the guy in NASA who is charged with looking at O'Neill's stuff and other concepts like that. The long-range planning for NASA.

Anyway Jesco took his planning, which goes out through the year 2000, and some very nice graphs and slides, and went up to the Star-Trek conference in Chicago. He went to attend it, really. Well, they asked him if he'd show his presentation, and he said he'd be willing, and they said all right, we'll get a room and you can put it on. Five thousand people attended the damn thing, and he ended up putting it on two or three times because of the interest.

I heard his presentation back about two months ago, and it was the first thing I've seen in NASA in a long while that really lit my candle. Jesco's got a very nice way of saying that you don't justify a trip to Mars or a space station around Jupiter right off the bat. But looking at the logical stepping stones that allow you to do it you find that each one of them has real practical value and will justify itself on practical grounds. The way in which he brings that across is very nice, because it takes all the work that he is doing in long-range planning and it says it isn't just dreaming, it causes you to think about the process and where it's going and what it will permit you to do.

I'm so excited about O'Neill's project because it presents a challenge that's worthy of interest and time and energy on the part of young people, where so much of what we're doing is sort of the drudgery of space flight. We're trying to extract a practical value out of a communications satellite and those kinds of things, which are useful, which are good, which I have nothing at all against, but which are not the kind of a challenge which is going to cause somebody to climb Mount Everest.

NASA

1964, Moffett Field, California. Schweickart flies simulated Gemini re-entry in the centrifuge.

SB: Well, we're hearing from quantities of those young people. They're in high school or they're in college, and they wonder what they're supposed to study to be of use. What do you tell them?

Schweickart: I generally point towards the sciences. The number of people who are going to be up there – it's something like airlines. You've got a lot of passengers in the back and you've got about three or four people up front who are doing the flying. After all, the glory days are gone in a sense. There's a lot of exploring left, and there's a lot of room for the individual, but the fact of the matter is that when we start operation of the shuttle we're going to have bus drivers and we're going to have passengers. That's a very unglamorous way to put it, but the flying is going to rapidly move toward routine, and the exciting thing is going to be what's done up there in that new environment. That's where the volume is going to be. You can transport a hell of a lot of people with a fleet of ten buses and 20 bus drivers.

SB: What are the passengers going to be doing?

Schweickart: They're going to be doing earth observing of all kinds – meteorology, oceanography, earth resources, forestry, agriculture (both in space and observing earth features for agricultural benefits). They're going to be doing all different types of astronomy – radio astronomy, optical astronomy, a whole new infra-red and ultra-violet astronomy, areas of the spectrum which aren't even open yet. They're going to be doing things like materials processing – operations where weightlessness is involved in the process, or very large capacity high-vacuum operations. Things that actually directly utilize the characteristics of the space environment. That whole realm of metallurgy and biological research into the effects of weightlessness on living organisms and materials. God, it just opens wide up. Anybody in almost any kind of physical science or engineering I think is going to be involved. The things in which I don't see direct involvement are the social sciences and the arts, at least in terms of government sponsorship. Now, when we get to taking passengers, I hope to hell we have a lot of artists and poets and other people going up.

SB: Here's a datum for you. As you know, our contributors are mostly environmentalists and are mostly against Space Colonies. But our graphic artists are almost universally for them – people like Arthur Okamura, Dean Fleming, Steve Durkee.

Schweickart: Where is Durkee now? Is he still in New Mexico at the Lama Foundation?

SB: Yeah. Do you know him?

Schweickart: Well, I've got a very good friend who's one of his best friends, who runs a thing for the University of New Mexico. It's a sort of a retreat near Taos at the D.H. Lawrence ranch. The Lama Foundation sits right down the road from them, and Al does a lot of sort of free labor for them, advice on mechanical things. Anyway, through Baba Ram Dass [**Be Here Now**] and Durkee's work with the Lama Foundation putting out the book, I developed an interest, but I've lost track the last few years.

SB: Do you know Ram Dass?

Schweickart: I don't know him personally, but I sure know his stuff. I've been following the guy since he was Richard Alpert at Harvard.

SB: We'll have to try to get you guys together some time.

Schweickart: I'd love to. We have a lot of common interests, I know that. You know, I never really wrote you back a letter and said anything to you, but it's on my tongue right now, and I think the kind of stuff you're doing with CQ is absolutely fantastic.

SB: Thank you!

Schweickart: I'm not trying to pull your head up, but I think very much of the kind of stuff that Bill Thompson's trying to do with Lindisfarne, the kind of thing that you're doing, the Steve Baers, the whole thing that you're wrapped up in there, and I sort of vicariously have one foot into it while the other one is still in the system.

SB: Vicariously, hell. You probably detected me going into interview mode a while ago.

Schweickart: Yeah, I was kind of chuckling about it.

SB: I put a tape on to be sure that I was getting a few things right that you were saying, and realized that I was hearing more good stuff than I've heard in months. What I could do if you're at all interested is work up a transcript of what we've been saying and let you look at it and see how you feel about it, and if it seems publishable, I'd love to do that, because what you're saying adds a whole other level of reality to this discussion. Mostly people are talking in this issue about space colonies as if it were an academic debating point but nothing that's actually going to happen. It's all sort of hypothetical. Some of your discussion I think would help bring it so much right down to cases for people that it would keep that pressure on them that it really is possible.

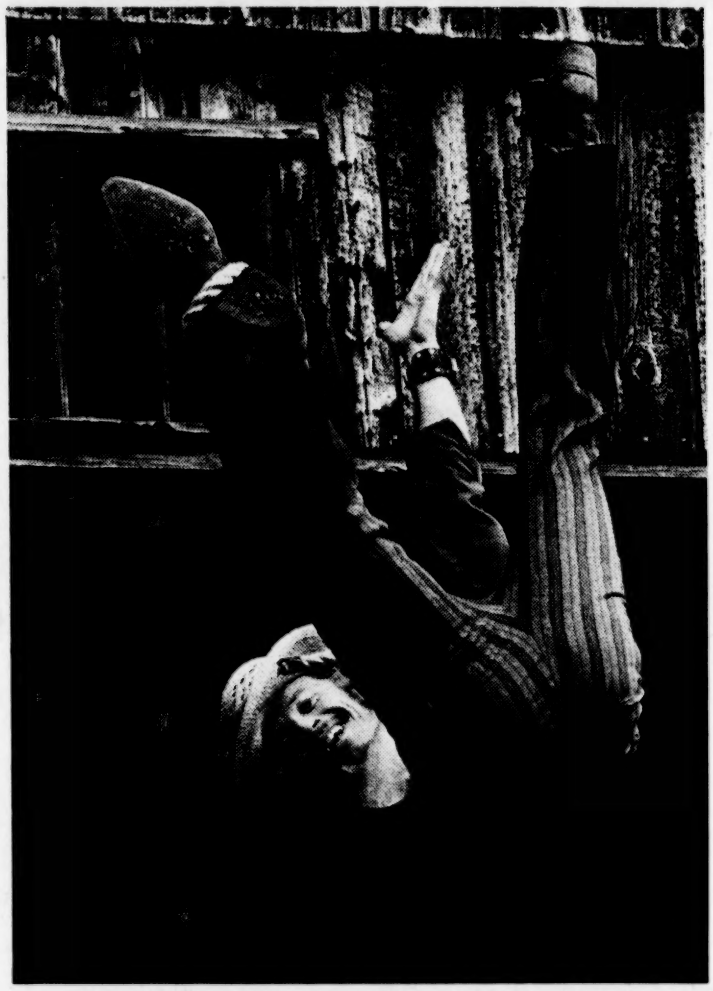
Schweickart: I have no problem with that. If you think you can make something worthwhile out of it, that's fine. The point you made is very interesting, and it's one that I've seen happen within the space program in the eleven years or so that I've been associated directly with it. Even in something like the Apollo program, or right now the shuttle program, people go along every day spending ten hours a day putting tremendous amounts of energy into the engineering, the design, all the hassles that go into making something like that happen, and they'll go that way for a couple of years and then one day they'll have a trip to California or somewhere where the actual hardware is that they've been messing with and are so familiar with that they can't stand it, and they'll finally get to the point where they actually see the hardware, and all of a sudden this reality sets in. They've been fighting the budget battles before Congress, and they've been doing all the hard engineering trade-offs, and all those things for years, but it's academic even to them until one day suddenly they realize, "By God it's real." People have got to recognize that the Apollo concept when we started out back in 1962-63, with the idea of landing a man on the moon and coming back to earth, that was at least as far out as O'Neill's space colonies. And seven years later in 1969, the 20th of July, a damned good friend of mine named Neil Armstrong put his damned foot on the moon and said here we are.

SB: What was the point of reality producing for you?

Schweickart: In Apollo?

SB: Yeah.

Schweickart: I think it was when I started traveling out to Rockwell in Downey and actually sitting in that spacecraft in the middle of the night. We'd test equipment and go through the development stage for 24 hours a day, seven days a week during a lot of it, and you would literally spend half a day in the spacecraft testing components as they went in and running the whole thing through different kinds of system and sub-system tests. Inevitably in something like that you have short periods of testing and long periods of trouble shooting and holding, and in those periods you basically sit there with a lot of time to think about it. That's useful time, but at 3 o'clock in the morning you tend to just sit there and realize where you are. "Here I am, a kid off a farm in New Jersey, sitting at three o'clock in the morning in the middle of a spaceship, a year and a half away from flying this thing off the earth." You can rap on it, knock knock, and it hurts your knuckles, and it's real.



August 1972, St. Johnsbury, Vermont. At a wedding reception Schweickart flies the rope hanging in the barn door.

The same thing happens to pilots, at least it happens to me when I'm flying. I fly a couple hundred hours a year in high-performance jet aircraft, and most of the time I'm busy getting somewhere, to a meeting, or a symposium or to a speech that I've got to make, or to something, and I'm thinking about the end point, the way you always do, but every once in a while it'll just be a spectacular night, and the milky way will be bright and the zodiacal light will be up, and the shooting stars are out, the whole place is a display. And you get to looking at it, and you say, "God, look at me, here I am flying! I'm a man, a creature with two legs, and here I am with an absolutely unexcelled view of the heavens flying along at 40,000 feet in a jet airplane, on those little bitty wings out there behind me. What a miracle!" It is an exciting exhilarating thing. People do it too seldom. You can do that when you're driving a car, when you're walking, when you're just breathing, but when you're in an unusual circumstance it's a little easier to do.

SB: Is there any chance you'd be flying out here sometimes in February? O'Neill will be in California, and it would be interesting to try and get you and he and Governor Brown together.

Schweickart: I'd like that. Let's see how schedules work out. There is one suggestion I'd like to make to Gerry O'Neill. I sure would like to have the inhabitants of those colonies have a relationship with the cosmos and not just be totally internal, inward looking. Their rate of rotation is considerably slower than the rotating restaurant at Los Angeles Airport, so if you wanted to look out you would see all right. You could design underground restaurants and meditation chambers where you could have a nice meal looking over a railing at the star scape, or meditate sitting on the stars. ■

Understanding Whole Systems

General Systemantics

You've heard of Parkinson's Law? Murphy's Law? The Peter Principle? Well this book is in the same spirit: a somewhat humorous presentation of some serious material. The author leaves proof of his axioms to your own experience, though intuitively you know that many of the axioms are all too true (most of the time, anyway). I was a bit put off at first. Too many laffs. But as I read along, I found myself being sensitized to some ideas that are all too often forgotten or overlooked; I saw disasters explained and potential disasters illuminated. I'd like to see **Systemantics** *combined with a general systems theory text. I'll bet this book is making the rounds in many an engineering dept. I like this book.*

—J. Baldwin
[Suggested by Dean Gengle]

General Systemantics
John Gall
1975; 144pp.
$5.00 postpaid
from:
General Systemantics Press
Box 71
Ann Arbor, MI 48107

A COMPLEX SYSTEM THAT WORKS IS INVARIABLY FOUND TO HAVE EVOLVED FROM A SIMPLE SYSTEM THAT WORKED.

The inverse proposition also appears to be true:

A COMPLEX SYSTEM DESIGNED FROM SCRATCH NEVER WORKS AND CANNOT BE MADE TO WORK. YOU HAVE TO START OVER, BEGINNING WITH A WORKING SIMPLE SYSTEM.

•

SYSTEMS DEVELOP GOALS OF THEIR OWN THE INSTANT THEY COME INTO BEING.

Furthermore, it seems axiomatically clear that:

INTRASYSTEM GOALS COME FIRST.

The reader who masters this powerful Axiom can readily comprehend why the United Nations recently suspended, for an entire day, its efforts at dealing with drought, detente, and desert oil, in order to debate whether UN employees should continue to ride first-class on airplanes.

Incredibly enough, the first big breakthrough in recognition of the GENERALIZED UNCERTAINTY PRINCIPLE did not come until the 1950's, when a daring — if anonymous — group of biologists toppled Watsonian determinism with one short, pithy aphorism, now known as the Harvard Law of Animal Behavior:

> **Under precisely controlled experimental conditions, a test animal will behave as it damn well pleases.**

The formulators of this Law failed to generalize to *systems as such*, thereby missing — by a whisker, so to speak — their chance of immortality: Not just animal behavior, but the behavior of complex systems generally, whether living or nonliving, is unpredictable.

•

SOLUTIONS USUALLY COME FROM PEOPLE WHO SEE IN THE PROBLEM ONLY AN INTERESTING PUZZLE, AND WHOSE QUALIFICATIONS WOULD NEVER SATISFY A SELECT COMMITTEE.

Item: When Pasteur accepted the challenge of the French silk producers to discover the cause of silk-worm disease, he had never seen, much less studied, a silkworm. He was not even a biologist.

Item: The Wright brothers, who built the first successful heavier-than-air machine, were bicycle makers.

GREAT ADVANCES DO NOT COME OUT OF SYSTEMS DESIGNED TO PRODUCE GREAT ADVANCES.

Furthermore:

COMPLICATED SYSTEMS PRODUCE COMPLICATED RESPONSES (NOT SOLUTIONS) TO PROBLEMS.

•

27. "SUCCESS" OR "FUNCTION" IN ANY SYSTEM MAY BE FAILURE IN THE LARGER OR SMALLER SYSTEMS TO WHICH THE SYSTEM IS CONNECTED.

Corollary:

IN SETTING UP A NEW SYSTEM, TREAD SOFTLY. YOU MAY BE DISTURBING ANOTHER SYSTEM THAT IS ACTUALLY WORKING.

•

32. LOOSE SYSTEMS LAST LONGER AND WORK BETTER.

Corollary:

EFFICIENT SYSTEMS ARE DANGEROUS TO THEMSELVES AND TO OTHERS.

Where Are The Earth's Erogenous Zones?

Why, below the Van Allen belts, of course!

—Toby Drew
Plattsburgh AFB, NY

The Earth IS an erogenous zone.

—Gene Stroop
Austin, Texas

That's aerogenous.

—Gaia*
Volant, Pennsylvania

***An inside joke for appreciators of Margulis and Lovelock's "Gaia Hypothesis" (Summer '75 CQ) proposing that the atmosphere is so much a functioning artifact of life that it might as well be considered alive. Incidentally, Gaia is a lady (pronounced "guy'-a").**

The tip of every mountain peak. They are all so splendid! Anyway whenever I am on one, it is like a big orgasm. Does that count?

—Peg Deminey
Albany, NY

Right where they're supposed to be!

—John Skelton
Rozel, Kansas

All around the Mediterranean, and California. I think the climate has something to do with it. Why do you want to know?

—Emily Elizabeth Cran
Montreal, Canada

The search goes on. Address answers to: The Vital Question, Box 428, Sausalito, CA 94965.

U.S. Photo Murals

Guaranteed fascination. Find the block you were born on, the stream you lost your virginity beside, your big town, your far peak — all in one picture for once. More detail per wall than anything comparable, and a bargain.

—SB
[Suggested by Roger Critchlow]

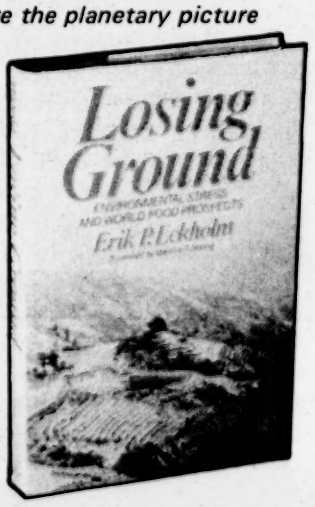
from:
Cartographic Division
Soil Conservation Service
Rm. G-110, Federal Bldg.
Hyattsville, MD 20782

Single print coverage	*14" x 21",*	*$ 7.50*	
	41" x 61",	*30.00*	
6-print coverage	*20" x 24",*	*7.50 per print ($45 total)*	
	40" x 60",	*20.00*	"
17-print coverage	*40" x 48",*	*18.00*	"
54-print coverage	*20" x 24",*	*7.50*	"
	40" x 48",	*18.00*	" *($972 — 40 ft. across)*

Losing Ground

Desperate news. Firewood is disappearing in the world. So are mountain environments, irrigation systems, fisheries, rain forests, and soil. Chapters from this book have appeared as major articles in Science, Natural History, *and elsewhere because of Eckholm's uniquely detailed perspective on environmental degradation in the Third and "Fourth" (impoverished) World. From there the planetary picture is stark.*

—SB



Losing Ground
(Environmental Stress
and World Food Prospects)
Erik P. Eckholm
1976; 219pp.
$3.95 postpaid
from:
W. W. Norton & Co., Inc.
500 Fifth Ave.
New York, NY 10036
or Whole Earth

By the mid-twentieth century, said the Chinese minister of forestry in 1956, the country had "the greatest number of barren hills in the world." Throughout much of the country only temple groves remained as a reminder of the original tree-covered landscape.

With life untenable for so many residents of the Andes, largescale migration to other areas is inevitable. As usually occurs when human populations are forced to flee an impossible situation, the movement out of the mountains has given rise to many new social problems.

•

Ecologically sound planning requires concern for the next decade, the next generation and beyond; only the strong and vocal support — or insistence — of an informed citizenry can allow — or force — leaders to depart from their usual fixation on the next month or year. A widespread public understanding of the ecological danger is ultimately the prime weapon for fighting any commercial interests — whether highly placed timber concessionaires in Indonesia or Pakistan or corporate farmers in Central America — threatened by environmental protection measures. If powerful economic and political interests oppose necessary reforms, then a stronger political force is necessary to override them, and information about the nature of the threats to well-being is essential for building such a coalition. This is broadly true of virtually all political systems — not just democracies.

•

Experience has proven that sound treatment of the land cannot be decreed by officials — particularly those viewed as alien or oppressive — and then forced upon people who do not understand why changes in their habits are necessary. Faced with serious soil erosion in their African colonies, the British in the 1940s and 1950s tried the coercive approach, and by any account the ultimate results were abysmal.

World Game, 1976

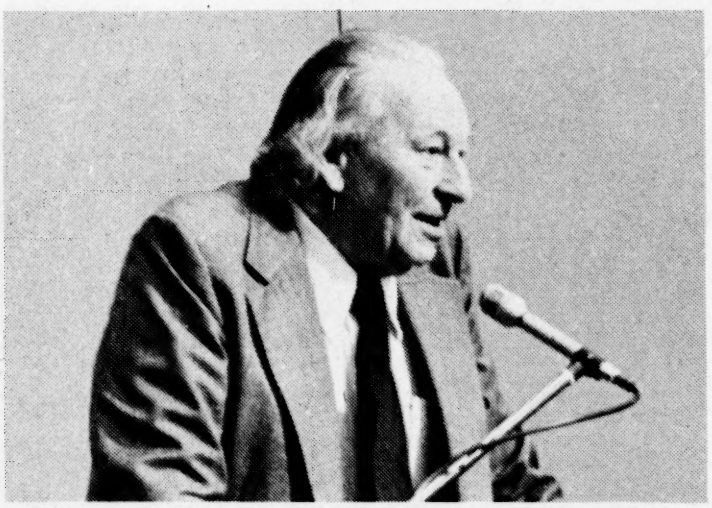
Another World Game Workshop with Buckminster Fuller will be held this year at the University of Pennsylvania, Philadelphia, July 3 - 31. Tuition for one-week symposium, $200; for the full four-week Workshop, $350. I'll be talking at this one. I don't know who else is. The Workshop of two summers ago resulted in the book Energy, Earth & Everyone *(p. 97). Write to: Earth Metabolic Design, Box 2016 Yale Station, New Haven, CT 06520.*

—SB

World model

. . . a comment on Limits to Growth made by a physics professor here, Jean DeLord, while displaying a world model flow chart:

> I look at this and I see an electronic circuit; inputs, outputs, amplifiers, resonators, etc. Now I know nothing about World Models but I know a lot about circuits. A circuit can do three things when you plug it in: it can do nothing, it can oscillate, or it can blow up. That's it.
>
> — Roger Critchlow
> Portland, Oregon



Prayer Breakfast

BY GREGORY BATESON AND GOVERNOR JERRY BROWN

I am an anthropologist. And the task of an anthropologist causes him to land himself in strange places. That is, places which are strange to him but of course not strange to the people who belong in those places. So, here I am at the Governor's Breakfast in what is for me a strange place but what is for many of you a place where you belong and have your natural being. I am here to relate this strange place to other strange places in the world where men gather together perhaps in prayer, perhaps in celebration, perhaps simply to affirm that there is something bigger in the world than money and pocket knives and automobiles.

One of the things children have to learn about prayer is that you do not pray for pocket knives. Some learn it and some don't.

If we're going to talk about such matters as prayer and religion, we need an example, a specimen, about which to talk. The trouble, you see, is that words like "religion" and "prayer" get used in many different senses at different times and different parts of the world. And what I would ask you is for a moment's agreement that at least while I'm speaking you understand that what I'm talking about is that which is illustrated by the following example.

A well-known anthropologist, Sol Tax, was working with a group of American Indians outside Iowa City some twenty or more years ago. They invited him to the National Convention of the Native American Church which was to be held quite close to Iowa City within a very few days. This is the church whose central sacrament is peyote – the little psychedelic cactus button which helps to determine the religious state. Now, the church was under attack for using what would be called a drug; and it occurred to Sol Tax, the anthropologist, that he would be helping these people if he made a film of the convention and of the very impressive rituals which would go with it. Such a film might serve as evidence that this worship is in fact religious and therefore entitled to the freedom which constitutionally this country grants to religion. He therefore dashed to Chicago (his home base) and was able to get a movie truck and some technicians and a stock of film and cameras. He told his people to wait in Iowa City while he went and talked to the Indians to get their approval of the project. What I'm going to read you is a statement about the discussion which ensued between the anthropologist and the Indians. (This account comes from a book called *Man's Role In Changing The Face Of The Earth* which was a conference symposium from the Wenner-Gren Foundation, published in 1956. *[CATALOG p. 17].)*

> They could not picture themselves engaged in the very personal matter of prayer in front of a camera. As one after another expressed his views, pro and con, the tension heightened. To defile a single ritual to save the church became the stated issue, and none tried to avoid it. Not a person argued that perhaps the church was not in as great danger as they thought. . . . They seemed to accept the dilemma as posed as though they were acting out a Greek tragedy. As he [Sol Tax] sat in front of the room, together with the president of the church, and as he listened with fascination to the speeches, gradually the realization came that they were choosing their integrity over their existence. Although these were the more politically oriented members of the church, they could not sacrifice a longed-for and a sacred night of prayer. When everyone had spoken, the president

Practically the only ritual that the State Government of California has is the Governor's Prayer Breakfast, held annually in January. This year it was different. Instead of the usual church choirs and succession of non-sectarian sermonettes and prayers over gray scrambled eggs, the Sufi Choir lifted the 1400 attending businessmen and government staffers into startled attention. Gregory Bateson spoke into that attention, and Governor Brown responded. Then more Sufi Choir, working, as leader Allaudin said, from 1500 AD on back in time. Breakfast was fresh fruit.

The whole treatment, arranged by Governor Brown and Jacques Barzaghi, was a chancy break with tradition, but it worked, and the tradition probably deepened. Also the event continued a dialogue between Bateson and Brown which began in the Fall '75 CQ.

The night before in the Capitol building, Jerry Brown was showing the Sufi Choir around his office. "It would be nice to sing under the cupola," said one. "Let's do it," said Brown. Shortly after midnight the choir took a breath in the dim high space and sang "Oh Israel! . . ." The cupola sang it back. For audience, janitors came from all over the building.

–SB

CWO Erik O. Petersen

Sufi Choir and dancer. The newspapers said, "stripped to the waist."

rose and said that, if the others wished to have
the movie made, he had no objections; but then
he begged to be excused from the ceremony.
Of course, this ended any possibility for making
the movie; the sense of the meeting was clear.

There's a curious paradox in that story. That, indeed, the truly religious nature of the peyote sacrament is proven by the leaders' refusal to accept the pragmatic compromise of having their church validated by a method alien to the reverence in which they held it.

This example, however, does not define the word "religion." It only defines the hedging which is necessary to preserve religion from that changing of its context – that reframing which will turn it into the temporal and the secular. Perhaps only too easily into entertainment.

Let me give you another example to come a little closer to what I mean by religion. To show what is to be protected from various kinds of defilement. The following poem is probably well known to many of you. It is part of the story of a ship in terrible straits. The decks are littered with corpses who have died of thirst and one sailor, the "Ancient Mariner," survives to tell the tale. This piece is the central fulcrum – the turning point of the whole poem. I've always found it singularly moving.

The moving moon went up the sky,
And no where did abide:
Softly she was going up,
And a star or two beside —

Her beams bemocked the sultry main,
Like April hoar-frost spread;
But where the ship's huge shadow lay,
The charmed water burnt a way
A still and awful red.

Beyond the shadow of the ship,
I watched the water-snakes:
They moved in tracks of shining white,
And when they reared, the elfish light
Fell off in hoary flakes.

Within the shadow of the ship
I watched their rich attire:
Blue, glossy green, and velvet black,
They coiled and swam; and every track
Was a flash of golden fire.

O happy living things! no tongue
Their beauty might declare:
A spring of love gushed from my heart,
And I blessed them unaware:
Sure my kind saint took pity on me,
And I blessed them unaware.

The selfsame moment I could pray;
And from my neck so free
The Albatross fell off, and sank
Like lead into the sea.

Oh sleep! it is a gentle thing,
Beloved from pole to pole!
To Mary Queen the praise be given!
She sent the gentle sleep from heaven,
That slid into my soul.

The silly buckets on the deck,
That had so long remained,
I dreamt that they were filled with dew;
And when I awoke, it rained.

Of course I am not suggesting that blessing the water snakes made the rain come. That would be another logic from

CWO Erik O. Petersen

One of the Sufi dancers delighting Maj. Gen. Schober. The general is a hard-nosed soldier who was appointed by Brown to command the California National Guard. Schober's primary guideline is Mao's dictum: "Serve the people."

Brand

Governor's office after the Breakfast. John Lilly, Nora Bateson, Gregory Bateson, Antoinette Lilly, Jerry Brown. Governor: "Do YOU know when the hinds bring forth?" Bateson: "No."

another – more secular – language. What I am suggesting is that the nature of this matter which we are discussing – prayer, religion and the like – is most evident at moments of change – at moments of what the Buddhists call Enlightenment. And while Enlightenment may have many sorts of content, and while it may be triggered by many sorts of experience, I think it important here where we are discussing religion as related to government to notice how often Enlightenment is a sudden realization of the biological nature of the world in which we live. It is a sudden discovery or realization of LIFE.

Already the water snakes give us a hint of that. And another example which is even more vivid – perhaps less familiar, alas – is the case of Job.

Job you will remember is like Little Jack Horner. He sticks his finger in the pie and gives to the poor, and says, "What a good boy am I." He has a God who is exactly like himself and who therefore boasts to Satan about Job's virtue. Satan is perhaps the most real part of Job's person deep hidden and repressed within him and sets to work to demonstrate that Job's pietism is really no good. Finally, after infinite sufferings a God who is much less pious and pedantic speaks out of the whirlwind and gives Job three chapters of the most extraordinary sermon ever written, which consists simply in telling him that he does not know any natural history.

> KNOWEST thou the time
> when the wild goats of the
> rock bring forth? or canst thou
> mark when the hinds do calve?
>
> Canst thou number the months
> that they fulfil? or knowest thou
> the time when they bring forth?
>
> They bow themselves, they
> bring forth their young ones, they
> cast out their sorrows.
>
> Their young ones are in good
> liking, . . .
>
> (Job XXXIX, 1-4)

In conclusion I would like to say that I would be much happier about the world in which I live, about how my civilization is going to treat that world – the sorts of pollution and exploitation it is going to engage in and all the rest of that – if I felt really sure that my governors and my representatives know how many months the hinds fulfil and how they bring forth their young. □

Response by Governor Brown

"Since I have been in Sacramento I find that everyone is coming to government to find out what's going on. I have to ask myself where does government go to find out what's going on? I suppose we have come here this morning in recognition of the fact that all that we do across the street at the Capitol is dependent upon things and forces and a spirit which none of us control but all of us must respect.

"I remember when I first heard about this prayer breakfast. I was in the seminary about fifteen years ago and was horrified to learn that my father was going to pray with Protestants. Since that time we've all come a long way. I think we've all come a long way individually and collectively, because many of the apparent divisions that separate people and their ideas and their philosophies and their roles are not quite as different and separate as we thought.

"Even in this country of ours – as we enter our third hundred years – it is going to become more difficult and more imperative that we recognize that we're just a small part of a very large and diverse reality that none of us really understands very well. And although we see our technology and our progress and our knowledge and our data and plans and our pretenses, I can't help but wonder how much we've progressed from former ages and those people who lived in this area before we even got here – and those people who'll come after us.

"I don't have a text today but if I did I might look to the Old Testament where it is written that pride comes before a fall. And also where it is said that past glory leads to present weakness. I think we have to walk with humility. I think we have to realize that our technology can only take us so far; that our government can only give us so much; that all of us are connected and dependent on one another; and that the apparent divisions in our country and throughout this globe are just that, apparent. And ultimately, and hopefully sooner rather than later, we'll come to see that we all depend on one another; and this planet and its water, its air and the fruits of its soil must continue not only in this generation but for those who succeed it.

"There's a Spanish philosopher who said that patriotism is not so much protecting the land of our fathers as it is preserving the land of our children. I could ask nothing more for this state and this country and this planet." ■

Capitalism and Material Life

The book is divided into sections, rice, corn, beer, furniture, alcohol, iron and many many others. I found that I paid close attention to Braudel; most history books make my mind wander. He turns the usual history upside down, details and more details of everyday life but perhaps no mention of the King. All his discussions are filled with quotes from first hand. On horses and urban transport in eighteenth century Paris —

> At the end of the century two thousand seedy cabs plied for trade in the town; they were drawn by broken horses and driven by foul-mouthed coachmen who had to pay out twenty sous a day for 'the right to drive on the highway'. Congestion was notorious and we have many descriptions of it. 'When the cabs are empty,' said a Parisian, 'they are fairly docile; around midday they are more difficult, in the evening they are unmanageable.' And they were unobtainable at rush hours, for example at dinner time (for such it was) around two o'clock in the afternoon. 'You open the door of the cab, someone else does the same on the other side; he gets in, you get in. It is then necessary to go to the commissioner of police for him to decide who shall have it.' At such times a gilded carriage might be seen blocked by a cab crawling slowly along in front of it, at a slow and measured pace, 'all broken down, covered with burnt leather and with planks in place of glass.'

There are no chapters of theories concerning why this or that happened. Instead piece by piece you hear about furniture in China and Europe, alcohol in France, England and America. The details pour out of the book. Braudel has theories but they are stated succinctly and I felt that he would rather use a page to give you the essence of an age than any explanations of it.

> Europe therefore neither discovered America and Africa, nor desecrated the mysterious continents. The nineteenth-century explorers of central Africa, so greatly admired in the past, travelled on the backs of the Black bearers. Their great mistake, Europe's mistake at that juncture, 'was to think they were discovering a sort of New World.' Similarly the discoverers of the South-American continent, even the *bandeirantes paulistas* who set off from the town of Sao Paulo, founded in 1554, for all their wonderful epics, merely rediscovered the old tracks and rivers, with canoes used by the Indians, during the sixteenth, seventeenth and eighteenth centuries. And they were generally guided by the Mamelucos (Portuguese and Indian halfbreeds).
>
> The same adventure was repeated, to the profit of the French, from the Great Lakes to the Mississippi in the seventeenth and eighteenth centuries, thanks to Canadian halfbreeds, the *bois brules* as they were called. Europeans very often rediscovered the world with the eyes, legs and brains of others.

One of the nicest qualities of the book is that it can be opened anywhere and read for 20 minutes. Braudel has enough respect for life and the past to be immensely puzzled by it — so he never imposes some kind of false structure that you have to pay attention to.

—Steve Baer

Capitalism and Material Life 1400 - 1800
Fernand Braudel
1967; 445pp.
$4.75 postpaid
from:
Harper Colophon Books
Harper & Row
Keystone Industrial Park
Scranton, PA 10022
or Whole Earth

The Elements

Succinct articles on the basics — minerals, food, and energy. Keeps a weather eye on international news and trends in resource and agricultural development. Could be real useful to an understanding of the big strange picture. The editorial viewpoint verges on bleeding-heart socialism, but the taste in information is choice.

—Stephanie Mills
[Suggested by Dave Potvin]

The Elements
James Ridgeway, ed.
(monthly)
$5/yr individuals
$10/yr institutions
from:
Institution for Policy Studies
The Transnational Institute
1901 Q. Street, NW
Washington, D.C. 20009

NIGHTSOIL: On a "small and experimental" basis Hong Kong has begun to export nightsoil, solid human waste, to China where it is used to make methane gas for lighting homes as well as for fertilizer. Last June, **People's Daily** called for a mass movement to build more methane tanks fed by "human feces, guana, animal droppings, weeds, plant stems and contaminated water." The paper said it costs only $20 to produce such a tank that can make cooking and lighting gas for a family of five.

Le Sauvage

For you French-readers here's a magazine that covers roughly the same terrain as we do, from the European perspective, somewhat classier.

—SB

Le Sauvage
Eds. Jean Daniel, et al
$14.14 (64 F)/yr. (quarterly)
from:
Le Sauvage
12, rue du Mail
75002 Paris
France

Bill Dudcher, directeur du Tarzan Fan Club aux Etats-Unis

BY GARY SNYDER

High Quality Information

A life spent seeking it
Like a worm in the earth,
Like a hawk. Catching threads
Sketching bones
Guessing where the road goes.
Lao-tzu says
To forget what you knew is best.
That's what I want:
To get these sights down,
Clear, right to the place
Where they fade
Back into the mind of my times.
The same old circuitry
But some paths color-coded
Empty
And I'm free to go.

Poetry is the Eagle of Experience

All the little mice of letters,
Sorting boring papers,
And the rabbits of wood piles
The big Buck of a lecture in town!

Then, walk back into the brush
To keep fixing a trail.
High over even that
A whistle of wings!
Breath of a song.

The Earth's Wild Places

Your eyes, your mouth and hands –
The public highways. Hands
Like truck stops,
The semis rumbling in the shadows.
Eyes, like the bank clerk's window;
Foreign exchange.
I love all the parts of your body.
Friends hug your suburbs –
Farmlands are given a nod;
But I know the path
To your wilderness.
It's not that I like it best,
But we're almost always alone there,
And it's scary, but also calm.

Calcium Poem

The doe munches on rotten cow-skull
bone, she is pregnant
back of the woodshed
hooves rustling dry poison oak.
cement hardens up at the footings
poured for the barn.

Molecule by molecule
drawn in and saved by
single swimming cells,
a few sparks of Calcium
like Blue Whales
far apart and streaming through the sea.

Sociobiology

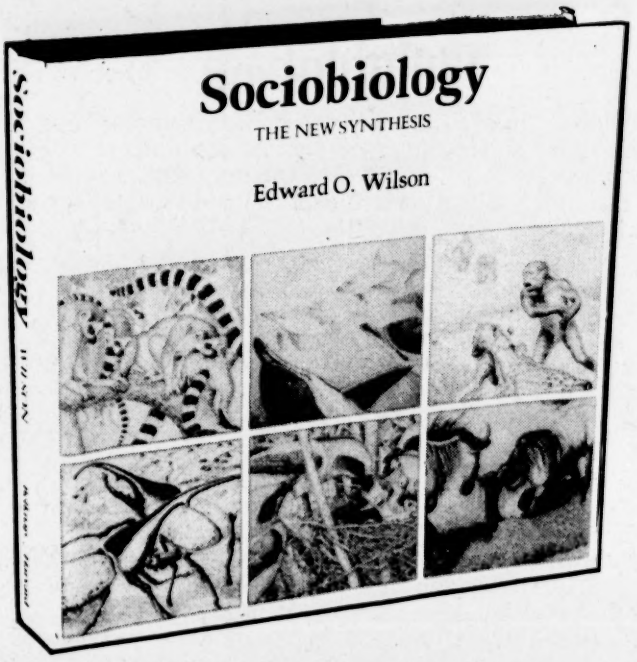
by Peter Warshall

When Stewart gave me a copy of **Sociobiology** to review, I thought "how fortunate." I took it home and immediately looked up my current love: dolphins. The first section was a weird diatribe against John Lilly (**Mind of the Dolphin**) which seemed off-the-wall, if not irrelevant. As I read on, I realized Wilson knew nothing about dolphins. He excuses the big dolphin brain by praising the dolphin's abilities to imitate (vs. reason). He totally ignores echolocation and the dolphin's ability to turn sound waves into "visual" images as additional causes of their huge brain size. He ignores a dolphin's ability to use two or three "voices" simultaneously (echolocation, identification whistling, and "social" talk). Even the "hard" science was sloppy. For instance, the rough-toothed dolphin (*Stenidae*) is considered by most taxonomists to be a separate family from the common dolphins (*Delphidae*) because of different vocal/lung tracts and different kinds of teeth. Wilson uncritically lumps them.

Totally disappointed, I turned to an old love: monkeys. Here my feelings were more complicated but I immediately began to quibble. Wilson seemed incredibly male-oriented:

> **. . . the key trait. . . is the degree of male involvement in social life. The variable is not only satisfying in itself but also reasonably well-correlated with other social traits such as group size, the nature of the dominance system and territoriality. . . (page 254)**

Well! Who is Wilson talking about? I looked in a summary chart under "uni-male" groups and saw the patas monkey, the hamadryas baboon, and the gelada baboon. But, all monkey-freaks know that the male patas monkey hardly ever acts in the group. He is a loner, wandering far from his lady in the tall grasses. The hamadryas baboon, on the other hand, is the total focus of group activity. Wandering females are herded and punished for straying. Among gelada, the male rarely attacks females. He prefers to woo her by walking or even running to her and presenting his thigh to be groomed. So, Wilson, in a book called **Sociobiology**, has made a most elementary mistake. He has confused broad groupings of animals (dispersion in space) with their social life (their temperaments, their pacing of being together and apart, their behavior as more or less social beings). This confusion between "geometric arrangement" of creatures in space and passionate, animal, living space became more and more obvious throghout the



book (see Part II of this essay). It comes, in primates (and the cats and the canids), from Wilson's total inability to integrate male and female existence.

For instance Wilson suggests that competing males try to become dominant and, by being the most dominant, gain reproductive advantages over other males. Essentially, the heaviest dude fucks most, fertilizes most, and populates most. Wilson does not discuss any of the monkey studies that show (1) dominance may be unimportant to the life of the social primates; (2) definitions of dominance are nebulous to incorrect; (3) dominance may not be at all related to hyper-dude-ism.

In these studies, monkey-watcher Lee Drickhamer reports that "high" ranking male rhesus monkies are more visible than "low" ranking, so scientists see them fuck more and score them higher. Susan Duvall and other monkey-scholars traced fatherhood by analysing baby rhesus' chemistry. They found that mere adolescent males and a few low rankers fathered as many offspring as the heavy dudes. While I was living with rhesus on two monkey islands, it was obvious that some lady rhesus chose their male partners and not vice versa. I. Bernstein and many others have seen the same.[1]

In short there is a worry here. Is Wilson just an ethnocentric American making mythology (male mythology) by selecting only certain scientific data to "prove" old-fashioned

Social behavior in the hamadryas baboon. . . The procession is beginning to break up into the basic social units, which consists of single males and their harems of females and offspring. Aggressive interactions are frequent and animated. The two males in the foreground threaten each other, the one on the right using a hostile stare while his opponent responds with a more intense gaping display. This exchange might escalate into a ritual fight, with rapid boxing and mouth fencing. The females directly behind the two males crouch, make fear faces, and scream; otherwise they stay out of the conflict. About 2 meters behind the right male, a younger follower male watches the exchange. Although he is teamed with the overlord and has been trying to acquire a harem of his own under the protection of this older partner, he is not likely to join the fight. Directly to his rear another overlord bites the neck of one of his females as punishment for straying too far. Her response will be to run closer to him.

Americanisms (like status-seeking, re: dominance)? For certain, this book has a huge perceptual gap when it comes to female existence. Compared to the long sections on males, the continuity of matrilineal (female-centered) cores or family groups (lions, mice, rhesus, elephants, wolves) has not been explored.[2]

* * * *

At this point, I returned **Sociobology** to Stewart and said that it was not worth reviewing. Stewart pointed out that the book had been highly praised by the press and kindly returned it to me saying I could write the first "don't-waste-your-money" review.

Sociobiology is not what its subtitle claims: "A new synthesis." At best, it is a compendium of carefully selected scientific papers, partially digested and regurgitated as scientific theory. Its interest is the hundreds of examples which read, at times, like a Ripley's **Believe It Or Not**. Those who like textbook prose and want to browse in reasoned academic thought will find this the most extensive compendium around. But, for open-minded thoughts on animal existence, you'll have to look somewhere else, (e.g. **Parable of the Beast** – CATALOG, p. 20).

A real synthesis of sociobiology would contain a discussion of the evolution of dreaming as it relates to social life, the evolution of intentional acts (acts done "on purpose"), the evolution of emotions and temperament as well as the development of self-reflective thoughts, awareness and states of ego-lessness. None of this appears in Wilson's book. Below, I will try to indicate their importance.

MOODS

Consider what we perceive: Monkey slaps the ground, bobbing his head in rhythm with the slaps, giving uh-huh after uh-huh grunts. The academic scientist says: "The movements are signals. Monkey is threatening that other monkey." The Caretaker: "Oh no senor, KT [the monkey's name], he is always angry. He has weird dreams, grinds his teeth at night. He mopes, is irritable." Note the difference. One man insists that an "interaction" is happening. There is a "relationship" of threat. The other man says Monkey has "states" or "moods." They are not to threaten or to interact – but simply an emotional expression of his internal consciousness (anger). **Sociobiology** does not ask these questions. The writing is anthropocentric. It does not question the human attachment of labels to animal movements and sounds. In this sense, it leaves the impression that animals are always communicating to one another by their movements and that humans know the meaning of the movements (a "threat" vs. an act of love).[3]

One night, in Arizona, I listened to a chipping sparrow sing as the full moon was eclipsing. He gave his full song again and again. I wondered if he was dreaming of his lady sparrow and their nest and had sung out because his dream was so real or if he was awake and singing because the moon was disappearing. To preach a bit: non-human (and human) life is filled with these mysteries and scientists must guard against labeling and theories that categorize too fast and facilely the meanings of animate sound and motion. An "open" science must be very skeptical of what it knows or thinks it knows. **Sociobiology** comes on with dogma – as if it had THE conceptual answer.

ARCHIE BUNKER

Returning to Monkey and his anger, we return to another central dilemma of social life. Are the movement/sounds of Monkey done "on purpose," for an intended reason or goal? Or is Monkey simply programmed by natural selection to "release" one gesture/sound after another monkey has, so to speak, pushed the right buttons (signalled)? Consider Archie Bunker. He has put away his mashed potatoes and roast beef, shuffled toward the TV, farted, turned the knob, sunk into a chair and pulled the paper over his face. He does this every night of the week. Is this will power? Is Archie Bunker just a behavioral program like Monkey?[4] What is monkey volition vs. human volition, and does their sense of purposeful pursuit of a goal differ? Once intentional acts or consciousness evolved in animals, the whole approach to social existence changes.[5]

Venus

our nearest planetary neighbor

Remember the black box with the Earth and Moon in it? Well, continuing the same scale (a double page spread – 13½" = 270,000 miles) Venus would be in the next issue of CQ, 193 pages from Earth. Mars, the next closest planet, will be 363 pages from Earth or 170 beyond Venus. Mercury would be next, on the 422nd page and our patron star, the Sun (43" in diameter at this scale, by the way) on the 689th. Out past the asteroids, giant Jupiter (4.3" across) would appear 2,889 pages later in the Summer '81 issue. We may yet see Saturn 40 CQs from now; Uranus, 86; Neptune, 138; and in the Summer issue for the year 2022 – Pluto.

CASTES AND CASTES

Mental evolution is totally absent from **Sociobiology**. We are left with the feeling that Hindu castes are based on equivalent mental powers as honey bee castes; that humans create their cultural traditions and social life in the same mechanical manner that, at least as Wilson believes, bees create their social complexity. We may ask why honey bee drones don't consider revolt very often in evolutionary time and why humans do. Can bees make the Mind Change that has lead to the continual revamping of human societies – mind changes that usually start with the perception that one can intentionally act to change one's existence? The differences between Bee Mind and Human Mind are not to be found in **Sociobiology**.

As I have been implying, this book is too ethnocentric and too anthropocentric. It is also too ego-centric. You must believe that the "self" is almost synonymous with "body" and that animals have no "self" – meaning image-of-themselves-in-the-world (aka Umwelt). If you believe this, you follow Wilson's "logic." It goes: physical needs (shelter, sex, tool, air, water) are the causes of evolution. Their pursuit is by competition. EGO-SELF needs (power, status, control) are mentioned in so far as they satisfy physical needs. Socio-emotional needs (trust, acceptance, companionship) are not considered causes of evolution. Non-Self states of existence or Non-Egostates are completely ignored by Wilson or changed into ego trips. These include love, freedom, aesthetics and creativity in non-human creatures.

Example: A baboon sits and contemplates the sunset.
Example: Baboons rip open a sleeping boa constrictor to remove a recently swallowed baby baboon.

These acts resemble self-less or ego-less states. They appear in insects, dolphins, fish and us. Wilson does not see the sunset because he calls the state "mystic," and "mystic" thoughts are somehow "not real." Wilson might understand how these states relate to social life if he reviewed the beautiful studies of animals seeing their self-image in mirrors.

Wilson says altruism is "self-destructive behavior performed for the benefit of others." But, the whole point of altruism (Christian, Buddhist or Kwakiutl) is the self-lessness of the act, the spontaneity, the immediacy. Altruism cannot be considered self-destructive because it is a self-less or non-ego act. Wilson's mind bends the language to a world that is all self-centered even in an act of selflessness.

The real mystery is how human social existence was (is) produced. What amazes me most about **Sociobiology** is the lack of discussion about domestication and civilization. I mean, just as we have domesticated the dog from the wild, we must have domesticated ourselves from small hunter/fisher/gatherer groups to semi-permanent agricultural groups and on and on. At each moment, a certain self-imposed selection of progeny and life-style probably occurred. Maybe not as drastic as, for instance, the Cheyenne turning the Spanish horse into the Indian pony in a 30 year period, but nevertheless some kind of feedback loop where man adjusted both genes and growth to his increasingly man-made ecology. Wilson does not discuss this.

[more →]

WOLF	DOG
Monogamous	Rarely, when they return to "wild"
Seasonal mating	Rare. Usually mate any time of year.
Increasingly wary of strangers as they age	Rare. Usually remain as friendly as their young personality
Shy of objects or new wolves at 5 months	Rare
Assertive parts of personality appear with sexual maturity	Assertive parts appear but not related to sexual maturity
Untrainable by humans	Trainable. By selection for retaining infantile traits

Consider the dog and the wolf. The dog has become out-of-synch with his sexual ecology. Seasonal mating no longer occurs. Monogamy is lost. Assertiveness no longer occurs when sexual maturity occurs but may occur before or after. At the same time childishness has been preserved. Dogs no longer get more suspicious of strangers with age. They no longer shy away from new objects after 5 months. And most of all, by retaining their childhood openness, they are trainable. This process of domestication (neoteny and more generalized sexuality) has close analogs in rodents, primates, cats and human behavior. There seems to be a close connection between domestication in animals and the development of modern civilization in man. What is amazing is that Darwin discussed this and Wilson, the evolutionist, appears totally ignorant of his thought.

THE RULE AND THE WAY

In summary, Wilson looks for the rules of behavior and hopes they are universal. He looks for the rules of dominance, territory, aggression, etc. But, this Occidental Mind trip (the Logos trip) appears very narrow-minded. A predominantly non-Occidental thought which looks for the Way of all creatures, not the rules, is needed. This more "open" thought is strangely more scientific at this point in the planet's history. Only by relaxing out of "rule" searching and seeing the flow of evolution (Darwin's moment of revelation during the Patagonian earthquake) can social existence and planet life be integrated. This book is a failure at seeing co-evolution and at understanding developing mind and consciousness – two foundations of the Big Picture. The footnotes list some books that will serve Whole Earth Mind more fruitfully. □

Sociobiology, by Edward O. Wilson; 1975; 697pp.
$20.00 postpaid from: Harvard University Press
79 Garden St., Cambridge, MA 02138

FOOTNOTES

(1) For a recent summary of Sex and Dominance see Science, 9 Jan. 1976, Vol. 191, "Primate Behavior: Sex and the Dominant Male," and Robert Hinde, The Biological Basis of Human Behavior, McGraw-Hill, 1974.
(2) This is a big topic that cannot be adequately summarized. Perhaps in another issue.
(3) The classic text on emotions is Darwin's Expression of Emotions in Animals and Man (Dover). This book is mentioned once in passing by Wilson and is not included in the bibliography. This book is a must for all budding St. Franceses.
(4) Thank you Michael McClure. The most central discussion of this problem is in Aristotle. But, more "modernistically" in Explanation of Behavior by Charles Taylor, Routledge & Kegan Paul, Ltd., London, 1964, or in The Organization of Behavior by D.O. Hebb, Wiley, 1949.
(5) An amazing number of "classic" texts of mental evolution and its relation to social behavior are missing from Sociobiology, giving the impression of mediocre scholarship. Principles of Animal Psychology by N.R.F. Maier & T.L. Schneirla, Dover, 1935, 1964, would be the most useful.
(6) Concepts in Ethology. M.W. Fox, University of Minnesota Press, Minneapolis, 1974. The Wild Canids, M.W. Fox, ed., Van Nostrand Reinhold.

Isak Dinesen

Gregory Bateson: Do you think our friend Stewart would like some co-evolution?

Judy van Slooten: Well, I dunno, Gregory. Which co-evolution did you have in mind?

Bateson: This. [Reads the following from Isak Dinesen's Seven Gothic Tales, "The Deluge at Norderney."]

Van Slooten: If he doesn't he's in the wrong business.

They closed the door of the loft, but as it was hanging loose, and kept knocking about, the Cardinal asked the women if they could not find something with which to tie it fast. The girl felt for the ribbon which had tied her hair, but it had blown away. Miss Malin then gracefully lifted her petticoat and took off a long garter, embroidered with rosebuds. "The zenith in the career of a garter, My Lord," she said, "is generally in the loosening, not in the fastening, of it. On that account the sister of this ribbon, which is now being sanctified by your holy hand, lies in the vault of the Royal Mausoleum of Stuttgart."

"Madam," said the Cardinal, "you speak frivolously. Pray do not talk or think that way. Nothing sanctifies, nothing, indeed, is sanctified, except by the play of the Lord, which is alone divine. You speak like a person who would pronounce half of the notes of the scale – say, *do, re* and *mi* – to be sacred, but *fa, sol, la,* and *si* to be only profane, while, Madame, no one of the notes is sacred in itself, and it is the music, which can be made out of them, which is alone divine. If your garter be sanctified by my feeble old hand, so is my hand by your fine silk garter. The lion lies in wait for the antelope at the ford, and the antelope is sanctified by the lion, as is the lion by the antelope, for the play of the Lord is divine. Not the bishop, or the knight, or the powerful castle is sacred in itself, but the game of chess is a noble game, and therein the knight is sanctified by the bishop, as the bishop by the queen. Neither would it be an advantage if the bishop were ambitious to acquire the higher virtues of the queen, or the castle, those of the bishop. So are we sanctified when the hand of the Lord moves us to where he wants us to be. Here he may be about to play a fine game with us, and in that game I shall be sanctified by you, as you by any of us."

It's the water – and a lot more

The enclosed is a great example of coevolution – very rapid upon the introduction of a new element into the environment. And a pretty far-out statement about sea otter's intelligence. It's from Cal. Fish & Game's employee newsletter.

–Dan Ray
Winters, CA

That an octopus can enter or exit from a container through the "pop top" was demonstrated when cans containing octopods were allowed to stand in full sun for a brief period of time. These octopus, some with an arm span of up to 14 inches, were able to ooze through the opening within one minute and without damage to themselves. This photo by Kim McCleneghan of MRR shows one emerging — driven out by the warm sun.

Oaks and the sweet smell of sex

Sex attractant chemicals called pheromones play a major role in the reproductive cycle of most moths. After emerging from her cocoon, the female moth releases a pheromone which draws the male moths to her. The males have no choice; the sexual pheromone triggers a tropism which forces them to fly toward its greatest concentration. Presence of the pheromone is usually essential to the moths' reproduction.

Several recent studies have shown that the oak leaf roller, a small, rather nondescript moth, is involved in a complex game with its host species of oak. The moth's larvae concentrate a complex biochemical produced by the new oak leaves and store it in their bodies through their growth period and metamorphosis. This chemical becomes the pheromone released by the adult females. The male moths excrete their share of the chemical while in the cocoon, then imprint to its odor during the critical first few minutes after emerging. When exposed to the leaves of their prey species, the male moths exhibit all of the responses they show to a female moth.

What has the moth gained by subcontracting out the manufacture of his most important exudate? He is freed of the genetic and enzymatic burden of manufacturing a complex hydrocarbon. He has gained the evolutionarily advantageous association of sex and the presence of food for the children (the adult moths don't eat oak trees). Both gains will increase moth reproduction.

It is to the oaks' advantage to continue to produce the pheromone. If it evolved away from production of the chemical, the moth would simply imprint to a different stored leaf product. The oaks have evolved so that they produce the most pheromone in the very earliest leaf growth. This has forced the moth to evolve toward early seasonal emergence, because larvae that feed on early leaves have more sexual pheromone than late larvae, and so, reproduce better. Thus the oaks are crowding the moth toward the Spring frost line. There is a limit to how far the oak can push the moth, because the oak cannot open its leaves too early and survive.

The moth has a tremendous advantage on the tree; its generation is less than a year. So, the tree must counter with subtle pressures. The moth has given up reproductive independence. A moth generation that strips the trees in the Spring will reproduce poorly and be widely dispersed due to low pheromone concentration around the trees. This will rest a defoliated tree for several years after heavy Spring infestation. Then too, a late Spring, on which the long-generation trees can count, will be catastrophic for the moths pushed into the danger zone by the milder normal years.

The evidence about the oak leaf roller is brand new, having been published in Science only a few months ago. The concentration and storage of the oak biochemical, and its release as a reproductive pheromone is fairly well established. The rest of the game is plausible speculation by several writers in the last few months. The confirmatory evidence for the whole circle is not yet in. Perhaps a synthetic pheromone sprayed on at leaf opening will lead the moths to doom at their next emergence. The next question is, "Where does the Douglas Fir Tussock Moth get its sexual pheromone?"

—Charles E. Aylworth
Bedford, Indiana

A Coevolutionary game: Feeding the Masses

In the hindgut of the ordinary little white termites that everyone is in such a hurry to exterminate are millions of little microbes of varying kinds: small round and rod shaped bacteria, larger flagellated protozoa and even some that move by writhing, violently, but go nowhere. They are, in general, indispensable to the life of the termite colony. Under logs in Virginia and the Carolinas are shiny rectangular wood-roaches. They too travel in great colonies. They too harbor an enormous assortment of microorganisms.

These insects can live on wood alone. Chemically this means cellulose and water. But "alone" in this context is deceptive. In the dark guts (and it is thought that the bacteria and flagellates have not seen the light of day since they evolved several hundred million years ago) food for the millions is mass produced. Some bacteria produce special enzymes that break down the cellulose of the wood into threads. Others break down the shredded fibers into sugars. Where does the nitrogen come from? Some special bacteria take nitrogen from the air and "fix" it into useable amino acids and protein. The violent writhers are thought to be the logical equivalent of electric stirrers: they shake up the brew.

When the insects become sexy, the little microbes are induced to form resistent packages. Newly hatching insects eat these packages, and growth of the microbes in the new hindguts begins again. Intolerant to extreme temperatures, oxygen, and other insults, the tiny symbionts are passed gently from insect to insect, generation to generation. Does anyone doubt the success of the system? Ask the exterminator.

—Lynn Margulis
Boston, Massachusetts

A discarded aluminum soft-drink container recovered by a sea otter inside the Monterey Bay breakwater at a depth of 35 feet. Upon surfacing, he bit open the can, let the can drop and then returned to his customary stomach-up, floating position and began to greedily devour the octopus he had removed from the can.

Co-evolution takes TIME

I remember once getting suckered into a ten-second move game of chess. I didn't know he was a former Jr. Chess Champion of Poland, they only told me that he was a friend who played a good game of chess. The bet with my friends was that I could last five minutes. Hell, that's only thirty moves, fifteen for him and fifteen for me, I thought, I can last fifteen moves against almost anybody.

I drew white. We set up the board and the game began. I took ten seconds. . . and moved. And he moved. I took ten seconds. . . and moved. And he moved. I took ten seconds. . . and moved. And he moved. He's not taking his ten seconds! And every time he takes less, I have to last more than fifteen moves! Worse, now I'm not taking ten seconds either. By now I'm just looking for empty spaces to move a piece.

He moves, I move. He moves, I move. No idea, no strategy, no plan, just speed. I have completely lost the concept of the game. It's all over in three minutes and twelve seconds.

I took the Evelyn Wood course once. I never use it. I don't know anyone who does.

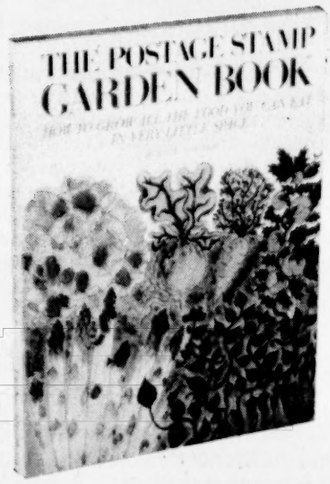
It is the Sixties Syndrome. We fill pages with solutions to the problem. We don't know what the problem is. What about PERFORMANCE? It is not enough to say no or more.

—my
Union, ME

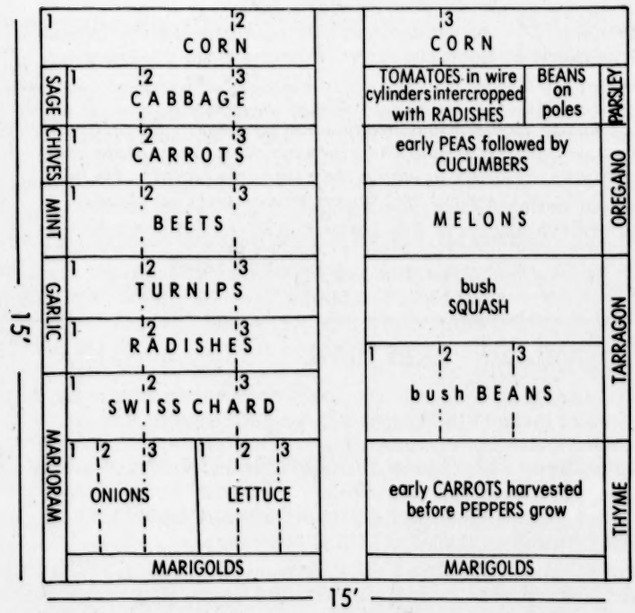
The Postage Stamp Garden Book

This is the first synthesis pure and simple of what I would call the Urban Gardening Method: a lot of compost, a few containers and French Intensive beds planted closely without mulching; seeds started in milk carton halves. Many city gardening programs wrote their own booklets because until now no single source presented quite this combination of techniques and traits of commercial seed varities. Excellent first-time gardening; follow-up with the Olkowskis' **City People's Book of Raising Food** *(Summer '75 CQ) which leads the way toward urban agriculture.*

—Rosemary Menninger



The Postage Stamp Garden Book
Duane Newcomb
1975; 148pp.
$4.95 postpaid
from:
Hawthorn Books, Inc.
260 Madison Ave.
New York, NY 10016
or Whole Earth



GARDEN 6. Here is the family food basket, large enough for a family of four (and some neighbors as well) and filled with most of the basic vegetables that anyone could want. Sections are planted in successive weeks and new seeds or seedlings are sown whenever spaces are harvested and become vacant.

•

Cool season crops—adapted to 55° to 70° F.:

Tolerant of some frost: asparagus, beets, broccoli, Brussels sprouts, cabbage, kale, mustard greens, New Zealand spinach, turnips and rutabagas.

Intolerant of frost at maturity: carrots, cauliflower, endive, lettuce, peas, rhubarb, Swiss chard.

Warm season crops—requiring 65° to 80° F. day and night (and readily damaged by frost): beans, corn, cucumbers, eggplant, melons, okra, peppers, squash, tomatoes.

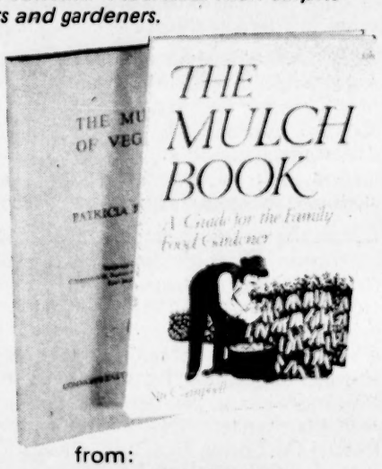
Mulch Books

Mulching can have a dramatic effect as protection from intense heat, cold or drought. It can also be costly and laborious, attracting pests and producing as many weeds as it kills. Both of these books tell the hows, whens and when-not-tos.

The Mulch Book, *the easier of the two to read, is a quick run through of the basics and some details applicable to the northern U.S.*

The Mulching of Vegetables *is the British Bureau of Agriculture at its best, documenting international mulching research since the 1700s. What worked in Brazil was disastrous in Yugoslavia. Conclusions as to why. Tells some subtle potentials of mulching: delaying or speeding a harvest; affecting nutritional content. Addresses itself surprisingly well to both farmers and gardeners.*

—Rosemary Menninger



The Mulching of Vegetables
Patricia Rowe-Dutton
1957; 164pp.
$2.60 paid in advance
from:
Commonwealth
Agricultural Bureaux
Farnum Royal, Slough
SL2 3BN England

The Mulch Book
(A Guide for the Family Food Gardener)
Stu Campbell
1973; 131pp.
$3.95 postpaid
from:
Garden Way Publishing
Charlotte, VT 05445
or Whole Earth

Fortunately the common organic mulch materials do not vary very greatly in their effect on crops, as shown by Isenberg and Odland (1950) using sawdust, leaves, grass clippings, straw, corn fodder and manure. So the grower is generally justified in using the most convenient and cheapest material available.

— The Mulching of Vegetables

BLACK POLYETHYLENE MULCH. Lay the plastic before you plant, being sure the soil is fairly moist first. Be certain that it is weighted down properly and that all edges are covered with dirt so the wind can't get under it and blow it away. Cut round, X-shaped or T-shaped holes in the film so plants can grow up and water can go down.

—The Mulch Book

Comfrey Report

Dr. Rateaver has edited for Americans the many years of research reports on comfrey done by Lawrence Hills and the Henry Doubleday Research Association. Comfrey can, under optimum conditions, produce more protein per acre than soybeans. It is also the only land plant known to extract vitamin B12 from the soil. One section of the book explains its use as a healing herb for people, but it also cures several ailments in livestock. The leaves are rich enough in NPK to use as fertilizer without even bothering to compost them first. Sounds remarkable, but there's plenty of data to back up these claims.

—Richard Nilsen

Comfrey Report
Lawrence D. Hills
1975; 139pp.
$5.50 postpaid
from:
Bargyla Rateaver
Pauma Valley, CA 92061

Comfrey was a "health food" for horses traditionally used by gypsies to put a gloss on the coats of bad bargains.

Vegetable Crops

This is a classic. An Ag school text since 1923, still in print and a truck gardener's dream. It's the book I consult most often because it gives more information on the traits of each vegetable than gardening books do. Also, in trying to deal with the infinite variety of growing conditions, it explains many problems that arise. One new insight it gave me was that manipulating greenhouse conditions, particularly temperature, in the first few weeks of life can effect specifics of the plants' later growth in the field.

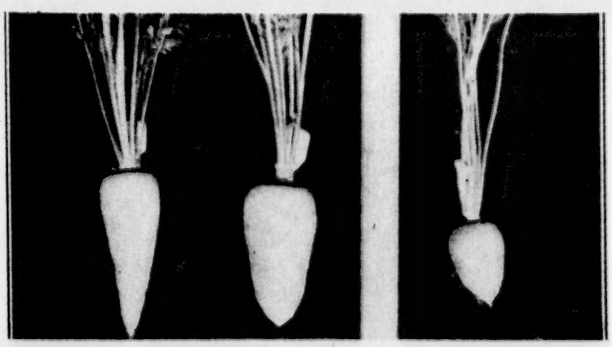
The book has been updated since '23 to include some use of chemicals, but it remains unique as a manual on commercial growing without a heavy chemical emphasis.

—Rosemary Menninger

Vegetable Crops
Homer C. Thompson &
William C. Kelly
1957; 600pp.
$14.50 postpaid

from:
McGraw-Hill Book Co.
Princeton Road
Hightstown, NJ 08520
or Whole Earth

Experimental results obtained by many workers have shown that crop plants have a marked effect on yields of those that followed. In experiments at the Rhode Island Experiment Station it was shown that mangels, rutabagas, cabbage, and buckwheat had a marked depressing effect on the yield of onions that followed. On the other hand, the yield of buckwheat was highest following rutabagas. . . . The very low yields of onions followed the crops mentioned above, and the highest followed timothy and redtop and redtop alone.

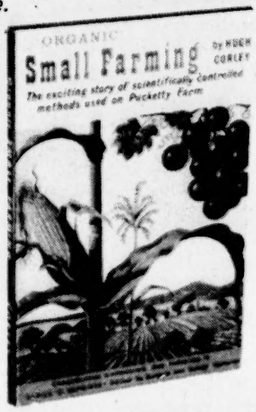


Effect of temperature on the shape of carrot roots. Plant on left was grown at 50 to 60°F., the one in the center at 60 to 70°F., and the one on the right at 70 to 80°F.

Organic Small Farming

A leisurely tour around a 185 acre diversified organic farm in England, together with the experience and tricks of the trade that made it work successfully. If it reads like a book from another era, it may be because Corley is up front enough to admit that he believes in his methods because they are traditional and express good taste.

—Richard Nilsen



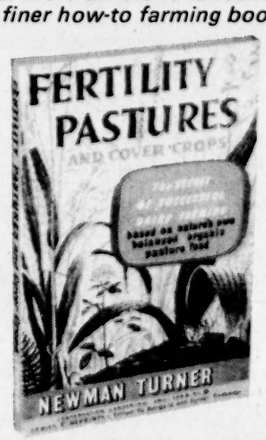
Organic Small Farming
Hugh Corley
1975; 200pp.
$7.00 postpaid
from:
Bargyla Rateaver
Pauma Valley, CA 92061

Mustard is the supreme crop for another of the functions of catch cropping. I mean catching soil nitrates before they leach away with the winter rain; other plant foods, too, but they are less likely to be lost. Locking the nitrogen up in organic form in the mustard (or other crop) at least delays and reduces the loss. This catching of nitrogen is the chief reason why wheat does so well after mustard. By early spring when the wheat really needs the nitrogen, which was there in such abundance in the autumn, the mustard is rotting well and yielding up the nitrogen it saved in its tissues.

Fertility Pastures and Cover Crops

If you graze lifestock, are planning a pasture, or can't afford the cost of concentrated feed, this book is worth the money. Turner was a gentleman farmer who had the time and curiosity to plant identically sized patches of 35 different grasses and herbs, and then turn his dairy cows loose and observe the order in which they were grazed off. He believed in a balanced diet for his stock, and that meant diversity. Included are 21 different pasture mixes, for different soil types, for early and late season grazing, even ones for chickens and pigs. Several of these mixes contain 20 or more different varieties of grasses and herbs. One of the finer how-to farming books I've come across.

—Richard Nilsen



Fertility Pastures and Cover Crops
Newman Turner
1974; 202pp.
$7.00 postpaid
from:
Bargyla Rateaver
Pauma Valley, CA 92061

HERBAL HEDGEROW MIXTURE
For supplementing existing pastures, particularly for goats.

	lb. an acre
Chicory	1
Sheep's Parsley	1
Burnet	1
Sweet Clover	1
Kidney Vetch	1
Ribgrass (Plantain)	1
Yarrow	¼
	6¼

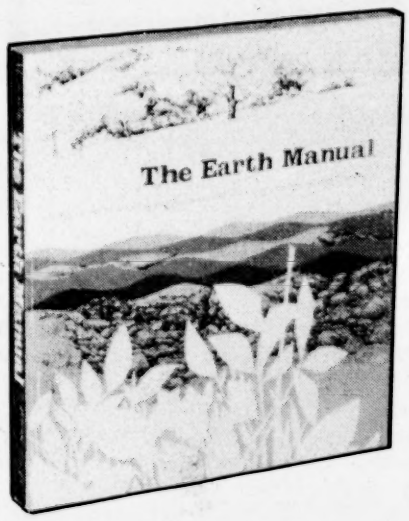
The Earth Manual

Just like the man says:

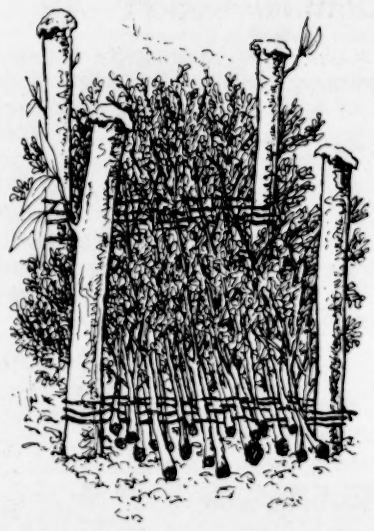
> Between well-trimmed suburban lawns and the vast regions of mountain wilderness, there are millions of patches of land that are semi-wild. They may be wood lots, small forests, parks, a farm's "back forty," or even an unattended corner of a big back yard — land touched by civilization but far from conquered. This book is about how to take care of such land: how to stop its erosion, heal its scars, cure its injured trees, increase its wildlife, restock it with shrubs and wild flowers, and otherwise work with (rather than against) the wildness of the land.

A whole book of gentle advice and easily-absorbed wisdom.

—Peter Warshall



The Earth Manual
Malcolm Margolin
1975; 190pp.
$5.95 postpaid
from:
Houghton Mifflin Co.
Wayside Rd.
Burlington, MA 01803
or Whole Earth



Brush mats are for really nasty places — places where you want to use a mulch but where the slope is so steep that you're afraid a loose mulch will wash down the hill. Believe me, an eroding hillside with a huge pile of soggy mulch at its base is a nightmarish sight. The way to avoid it is to use brush as your mulch and tie the brush together into mats.

To make a brush mat, first lay two wires parallel to each other on the ground, about two feet apart. Lay the brush over the wire. If you use fir boughs or pine boughs, pile them very thin; otherwise, they'll smother the seed. If you use sparser chaparral brush, you can make the mats as much as six inches thick.

After you arrange the brush over the wires, bring the wires back over the top of the brush. Use baling wire to connect the upper and lower strands of wire. Pull them tightly together and tie them off, making a connection every six inches or so. The loose ends can be twisted tight with pliers.

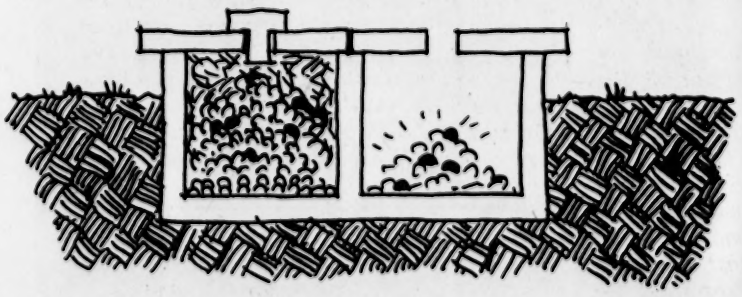
You now have a brush mat that will hold together very effectively, even on quite steep slopes. If you want to be extra safe, you can stake your brush mats down to the ground—preferably with sproutable, rootable stakes.

Rybczynski & Warshall on shit management

In the Spring 1975 issue of CQ there is a letter from Jim Burgel about his experiences in methane technology that seems to touch on the "primary reality" of methane vs. the secondary reality of media writing about methane. I very much share Jim's feeling about the limitations of bio-gas in temperate climates. Methane digesters with human waste input only, even if that is in sufficient quantity, are extremely difficult to run. My friend Bruce Etherington in Hawaii has been for some years trying to develop a "black box" for use by squatters in Manila, with whom he works. The principle is "shit in - fuel out." He has not had any success so far, and is becoming more cautious about his methanic hopes. This brings us to the application of bio-gas in rural areas, where animal wastes are available. Again I share Jim Burgel's conclusion that it seems to fit best in large scale agriculture, and in fact this has been borne out by the fact that Fry's installation was on a South African plantation (nice blend there of Alternative Tech and Authoritarian Tech) and the bio-gas plants in India, which cost about 2000 rupees (about 6 months income for a small farmer) and are utilized exclusively by large landowners. I don't bring these examples up to discredit the definite advantages of bio-gas, but rather to point out that there is no conclusive evidence that they represent a viable solution for the small farmer. This brings me, as it does Jim Burgel, to composting as a basis for recycling human waste. Since producing "Stop the Five Gallon Flush" we have become convinced that this is the most promising direction for rural sanitation. This is borne out by experiences in North Vietnam during the period 1961-1965. I am indebted to my colleague Krisno Nimpuno, who first brought this to the attention of the West. The North Vietnamese toilet, thousands of which are in existence, consists of two watertight compartments where only faeces are collected. Urine is drained away separately, being considered the 'lesser evil' from a point of view of micro-organisms and disease carrying parasites. When one compartment is full it is filled with green leaves, and sealed. A composting process takes place within, and after three months, dry sterile manure can be retrieved. Meanwhile the other compartment has been in use, and the cycle starts again. It is estimated that in Vietnam 600,000 tons of fertilizer are produced each year in this way. Beautiful.

This brings me to the sketch of an oil drum composting toilet shown in Jim Burgel's article. There are some real problems here. The interior tends to become a soggy mass, which may go septic instead of mouldering. Liquid waste is going to drip out of the vent holes. Nevertheless since Jim has built a number the question arises why they would work. I would think that they are used by only one or two people, and the liquid input is thus small. A toilet like this after a party becomes a virtual septic tank, decomposition stops, fermentation begins, smell etc. The same goes for the Farallones privy (which appeared in the EPILOG) and which simply does not work. It is absolutely crucial in these simplified composting toilets to 1) keep urine out, and 2) make sure that enough cellulose-type materials (leaves, paper, food scraps) are added to "fuel" the process. The Clivus-Multrum does accept urine, but has a complex series of ducts to promote evaporation, and an extremely large capacity which makes it more "tolerant" of changes in temperature and humidity within.

Incidentally, beware of small electric composting toilets that are Scandinavian in origin but are now being marketed in Canada, and probably in the U.S. Many of these have been discredited in Sweden, and residual production seems to be showing up here. They are fine for a vacation cottage and minimal or infrequent use. Any sudden large input of urine will result in disaster. A unit recently installed in an Eskimo village ended up being thrown out of the house by its owners. This is understandable when one realizes that an Eskimo



The North Vietnamese double composting toilet. Faeces only; ashes, paper and leaves added. The left compartment is full and composting. The right compartment is in use.

Wildflowers and Weeds

The best wildflower guide to date. Great key (using simplified taxonomy). 650 fine color photos. Accurate habitat notes. Pocket size. You couldn't ask for too much more.

Covers the Great Lakes Region of US/Canada. But, excellent for the Eastern Hardwood forest, the Great Lakes mixed Forest, the Northern Conifer Forest and the open prairies.

—Peter Warshall
[Suggested by David Mladenoff]

Wildflowers and Weeds
(A Guide in Full Color)
Booth Courtenay &
James H. Zimmerman
1972; 144pp.
$9.95 postpaid
from:
Van Nostrand Reinhold Co.
Order Dept.
300 Pike St.
Cincinnati, OH 45202
or Whole Earth

A man must see before he can say.
—Thoreau

This workbook is designed to help you *see* the wildflowers, those surviving without, or in spite of, man's hand.

TWINFLOWER fl. ½" long

TINKER'S WEED fl. ½"

BUSH HONEYSUCKLE
fl. ¾" long

HONEYSUCKLE FAMILY

BUSH HONEYSUCKLE, *Diervilla lonicera* / June–July / ½'–3', erect to arching / Dry or rocky woods and forests, cliffs / Flowers yellow to red; leaves finely-toothed
(Other woody Honeysuckles, *Lonicera*, differ in having untoothed leaves.)

TINKER'S WEED, *Triosteum perfoliatum* / May–June / 2'–4' / Dry to medium woods / Leaves vary from slender-based to joining around stem; flowers red to greenish-yellow

TWINFLOWER, *Linnaea borealis* / June–Aug. / Flower stalks to 5" / Moist to dry forests / Flowers fragrant; plant creeping, evergreen

MOCK CUCUMBER fl. ⅜"

---

household uses 5-10 gallons of water daily in brewing tea. The toilet became literally full of shit. A secondary aspect of small composting toilets was pointed out to me recently by a biologist. People shit like horses, not cows. Solid waste comes out in compacted turds which if dried too quickly turn into a hard rock-like substance which will clog rapidly any small device, and is extremely difficult to break up.

I am sure that at this point I have completely put you off your lunch so I better stop. I hope that this material might be of interest to CQ readers. Keep your blend of skepticism and polemic. We need it.

Best regards,

Witold Rybczynski
Minimum Cost Housing Group
McGill University
Montreal, Canada

•

Dear Witold,

On methane, I totally agree.

On electrified compost toilets, I totally agree.

On compost privies, there's more to say.

The CLIVUS: In general, the Clivus has proven to be a fine, working design. Everybody I know who has installed the Clivus starts with fly problems. The Clivus seems hard to seal. With patience and good detective work, the holes have also always been found. But, at first, there are flies in the feces. The Clivus seems to work with 6-8 people. But, up the number to 15 and it goes septic. All Clivus toilets seem to puddle (have liquid) at the bottom of the first chamber. This small septic puddle is unimportant until 12-15 people start daily use. (I'm sure it's different in different climates.) The Clivus people now seem to recommend two (not one) year of composting before removal. This is OK except when heavy use fills the second chamber sooner. Adding insulation and perhaps a little heating to the Clivus at the Farallones Institute (northern California) would help the composting. Probably, in other areas, a little more warmth is needed. Finally, the Clivus is not too easy to manage when it does overload. I mean there is little access to the first chamber if you wanted to further aerate the pile by turning it over.

The FARALLONES: I totally disagree with you that the Farallones privy "simply does not work." There is one at the Tassajara Zen Center that has worked fine. The Farallones Institute privy worked well with 20-30 people using it for a few weeks. It normally serves 12-15 people. Another (the funkiest) in Sausalito serves 2-3 people just fine. These notes from Dave Katz of the Farallones Institute: Men do not piss in their privy (reducing liquid). Women do (see below). The privy is managed very carefully. Saw dust and leaves are added to keep the C/N and liquid content around the right proportions. Heap temperatures measure around 140°. The Farallones privy is turned weekly and it takes about 4 months to compost. Note: The Farallones design allows easy management since access to the pile allows turning it with a shovel ("aerating") and monitoring the moisture/temperature. Especially for its price, the Farallones design looks the best so far. (The Farallones privies seem to have the same initial fly problems as the Clivus. Both solvable.)

The OIL DRUM: We are learning that small remains beautiful only as long as small numbers of people are involved. The Clivus can be overloaded just as a septic tank/drainfield system can be overloaded. The Oil Drum Compost Privy works well with two to four people. It is being improved at the Paradise Valley Land Trust where friends have been working with Jim Burgel in mind. See Drawing. Again, pissing elsewhere helps.

PISS: Men can piss outside in rural areas. Recently, the Olkowskis suggested that pissing can be done in a 5-gallon container and diluted (1 piss to 5 water) and used directly around trees and other plants for nitrogen. The Farallones Institute is presently designing a urinal for women.

The Farallones (EPILOG, p. 487) will soon have an updated version of their compost privy booklet. I recommend it.

Thanks to David Chadwick (Zen Center), Dave Katz (Farallones Institute), Steve Matson (Paradise Valley Produce), Timothy Winneberger (Septic Tank Consultant).

—Peter Warshall

P.S. FURTHER NEWS FROM THE SANITARY FRONT: Don't buy the Bio-Flow advertised by Sears. For as yet undetermined reasons, they do not work. More in later issues.

Soft Technology

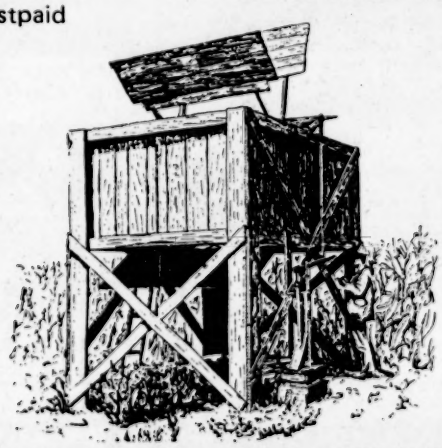
Homemade Windmills of Nebraska

Handcarved blades tipped with stainless steel? Ball bearings? Gears? Feathering mechanisms? Nope. A few boards and lots of "American Ingenuity" (for which this country is justly famed) make practical working machines that pump, saw, and in later times generate electricity. This paper was originally published in the 1890s and it's a real eye-opener. Funky, yes. Down-home, for sure. And it may well cause more people to make working machines than any wind-power book yet published. Interesting sociologically, too.

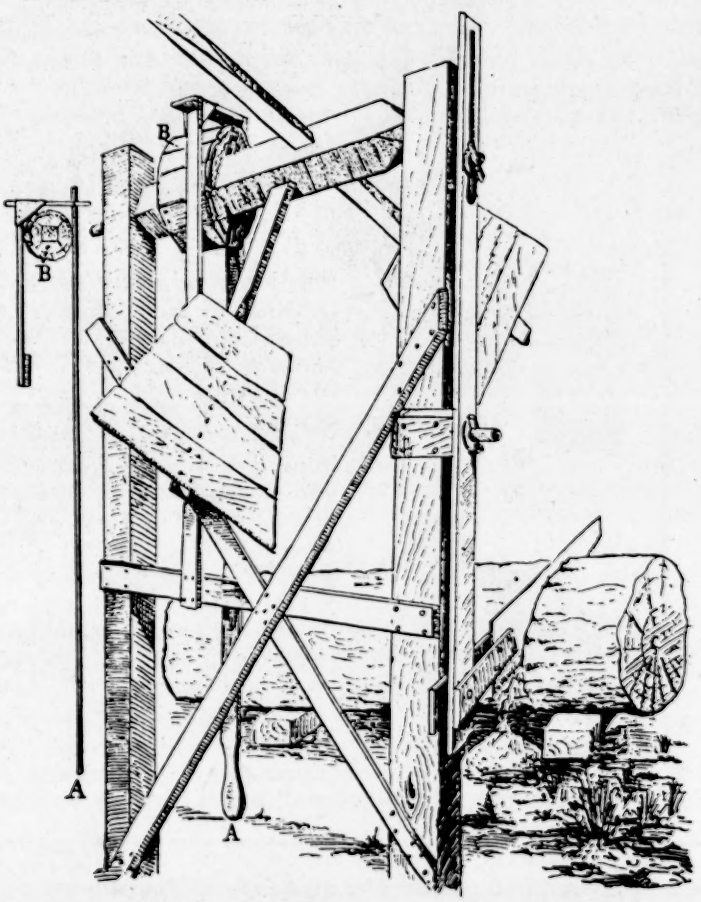
—J. Baldwin

Homemade Windmills of Nebraska
Erwin Barbour
1898; 78pp.
$4.00 postpaid

from:
Farallones Institute
15290 Coleman Valley Rd.
Occidental, CA 95465



A six fan Jumbo windmill on the farm of W. W. Goodrich, Bethany, Nebraska, used in watering a six acre patch of egg-plants for the Lincoln market. The fans are each nine feet long with arms five and one-half feet long. Jumbo box nine by eleven by six feet high, with door below for the escape of dead air. Extra well built. Axis of Damascus steel. Total cost, $8.00.

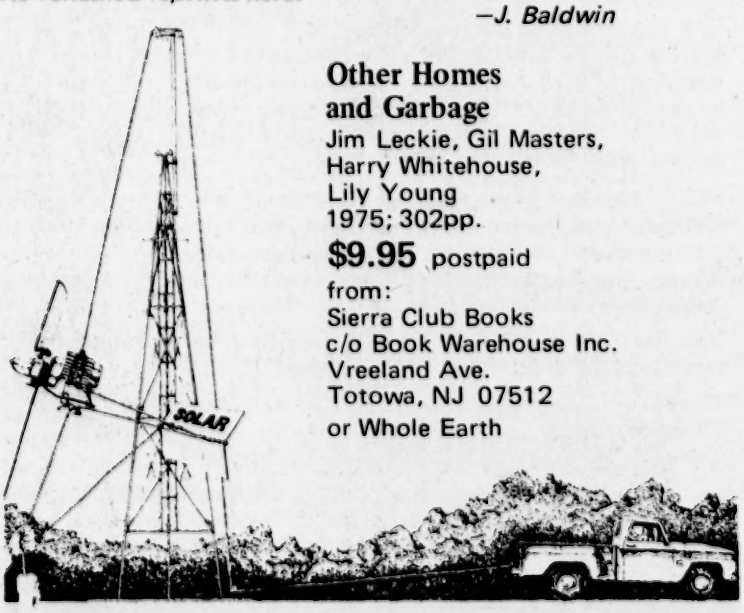


The Battle-ax windmill of Mr. A. G. Tingley, Verdon, Nebraska, as seen sawing a thirty-inch log. Diameter of wheel ten feet. The wooden drum and brake is self explanatory. This mill saws the wood for the family, and requires but little superintendence. To the left is seen a plan of the brake. The handle A cramps upon the wooden drum B. It is a cheap, simple, and satisfactory device.

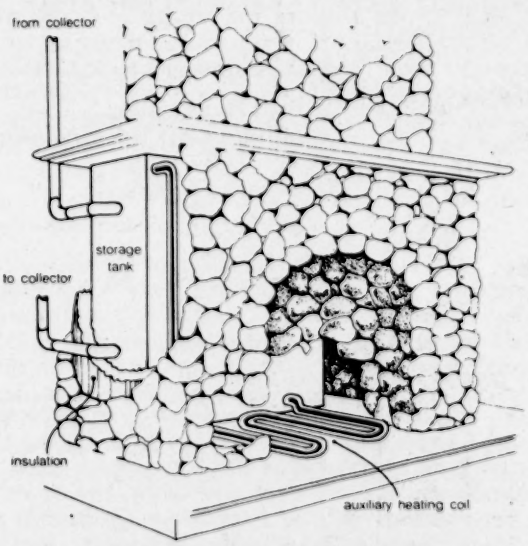
Other Homes and Garbage

This book is yet another overview of possibilities open to those interested in "self sufficient living," "alternative energy," and like that. But it's the best one. If you're not well informed in such matters, reading this through will fill your hopper, and there are enough numbers given to let you test the feasibility of your wildest fantasy. (For tight-standards work, though, you'll likely need more.) It's unusually well-researched and beautifully illustrated. No rehashed reprints here.

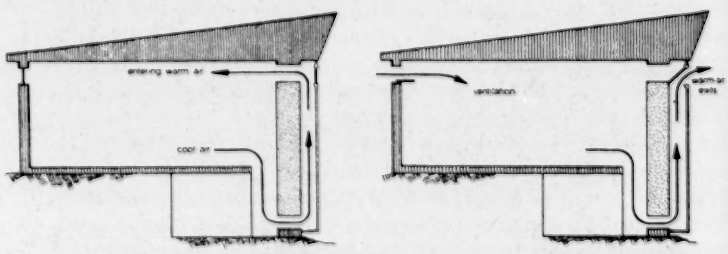
—J. Baldwin



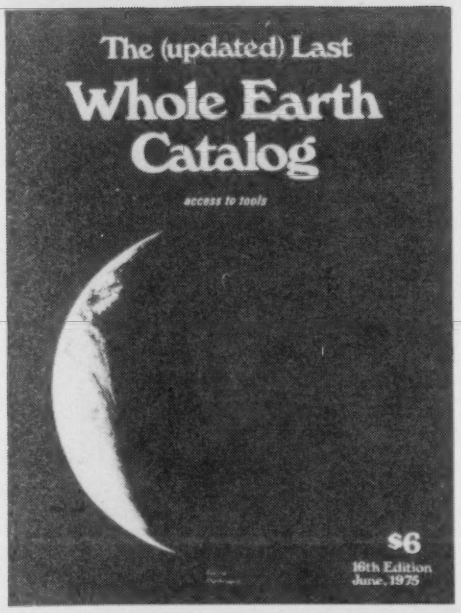
Other Homes and Garbage
Jim Leckie, Gil Masters, Harry Whitehouse, Lily Young
1975; 302pp.
$9.95 postpaid
from:
Sierra Club Books
c/o Book Warehouse Inc.
Vreeland Ave.
Totowa, NJ 07512
or Whole Earth



An integrated fireplace/storage-tank design (fireplace can be used as auxiliary heat source).

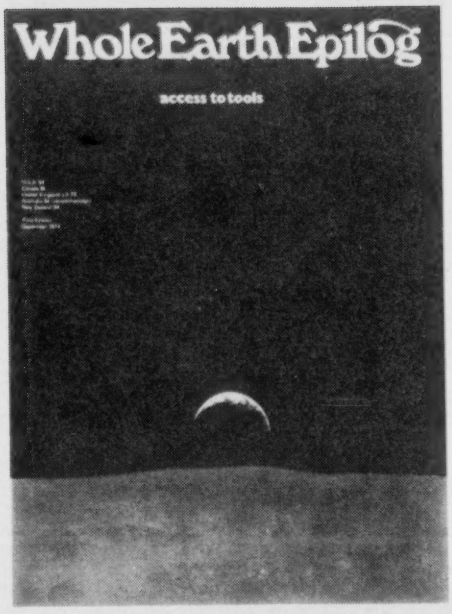


The Trombe-Michel house: winter and summer operation.



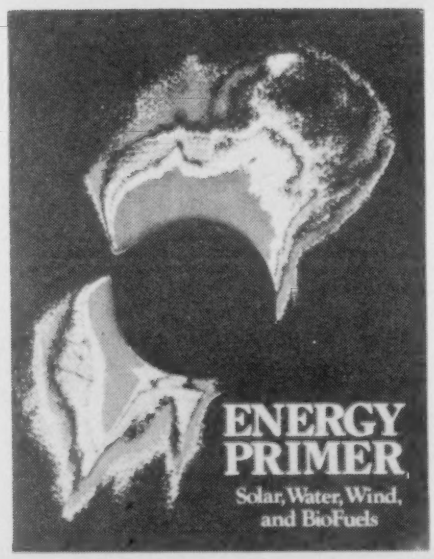
This space-age "Walden" affirms the ability of man, the individual, to survive in a world of increasingly dangerous technology. Not only does this work provide access to practical tools of free-form education, but more pervasively, it explores an optimistic philosophy of individualism. In form and content "The Last Whole Earth Catalog" mirrors the contemporary era as does no other work.

– Digby Diehl & Harrison Salisbury
National Book Award Citation, 1972



The EPILOG differs from THE LAST WHOLE EARTH CATALOG in several interesting ways. The quality of its information is better; its nine main sections are edited with greater style and selectivity; and its contents should appeal to a wider variety of people. . . . A confident and lively spirit of inquiry percolates through the EPILOG.

– Henry Moss
AD (Architectural Design)



A comprehensive, fairly technical book about renewable forms of energy – solar, water, wind and biofuels. Fifty pages of book reviews and hardware sources complement hundreds of illustrations and a dozen original articles.

200 pages
10" x 13" perfectbound
$5.50 USA/$6.50 foreign
$3.00 microfiche

Among many entrants in the general field it is the richest and most reliable. . . . The intimacy of the reviews of books and notices of purveyors of every type of related hardware lifts it above an ordinary textbook to the level of a knowing adviser skilled in the contemporary art. Libraries cannot afford to be without it.

– Philip Morrison
Scientific American

There's usually a book going around which inspires its readers to huddle in corners at parties, hashing it over. But a magazine? For the last year or so, CoEvolution Quarterly *readers have been seeking each other out as eagerly as oppositely sexed whooping cranes.*

– Henry Allen
The Washington Post

I would like to order the following:

- ☐ $6 – The (updated) Last Whole Earth Catalog
- ☐ $4 – Whole Earth Epilog
- ☐ $5.50 – Energy Primer
- ☐ $6/year – The CoEvolution Quarterly

Send to: **The CoEvolution Quarterly**
Box 428, Sausalito, CA 94965

Or use the postage-paid envelope inside the back cover.

☐ Back issues of The CoEvolution Quarterly
(See reverse side for contents):

____No. 2 ____No. 3 ____No. 4

____No. 5 ____No. 6 ____No. 7

____No. 8 ____Copies at $2.00 each
($1.50 to subscribers)

Total enclosed: $_____
(Check or money order payable to "The CoEvolution Quarterly")

_____
Name

_____

_____
Zip

6095

Back Issues

Order form on reverse side.. Issue No. 1 is out of print.

No. 2, Summer, 1974

Setting Food By *Doris Herrick*
Ehrlich's Guide to the Apocalypse: Food *Anne H. Ehrlich and Paul R. Ehrlich*
Tongue Fu *Paul Krassner*
Sanctity and Adaptation *Roy A. Rappaport*
Natural History Comes to Whole Earth *Peter Warshall*
Land Banking *Huey Johnson*
Gravity Engines and the Diving Engine *Steve Baer*
Sexual Honesty *Shere Hite*
New Games Tournament *Pat Farrington*
Salons and Their Keepers *Stephanie Mills*
Notes on Provisioning a Small Boat for Extended Cruising *Kathleen Pumphrey*
Apple Picking *Rick Fields*
Bookmaking Access *Robin Rycraft*
Making and Playing the Shakuhachi *Monty H. Levenson*
Gorf *Michael McClure*
The POINT/Penguin Books Publisher-Distributor Contract for the Whole Earth Epilog *Lawrence Klein*

No. 3, Fall, 1974

Edited by the Black Panther Party *Huey P. Newton, Elaine Brown, Ericka Higgins, David DuBois*

No. 4, Winter, 1974

"The whole system is out of whack" *Dale Jorgenson*
Energetics' Shortcomings *Hazel Henderson*
Enough Energy for Life & The Next Transformation of Man *Lewis Mumford*
The Creature and its Creations *Gregory Bateson*
This Superfluity of Naughtiness *Warren McCulloch*
"Where!?" *Carl Sagan*
Winemaking at Home *Phil and Mike Palmer*
Metric System Con *Steve Baer*
Man-Made Planets, Seriously *Graham Chedd*
A Canadian Home, 1973 *Robert Frank*
Lunaception *Louise Lacey*
Preventive Dentistry Primitive Style: A Case History *Walter W. Fingar and Stephen A. Ross*
Rich Is Beautiful! *Michael Slattery*
The Season Was Late. The Hunt Was Hard. *J.D. Smith*
To South America *Lynn Meisch*
The Great Gaming-House *Kelly Yeaton*
The Entire History of Man *my*
Dharma Taking Root in the (south) West *Zim*

No. 5, Spring, 1975

2025, If . . . *R. Buckminster Fuller*
Plains of Science, Summits of Passion *Kenneth E. Boulding*
Energy Choices *Medard Gabel*
Getting Specific for a Porpoise *Eugenia McNaughton*
Sociobiology *Gina Bari Kolata*
The Culture of Agriculture *Wendell Berry*
Horse Sense and Road Apples *J.D. Smith*
Small Tractors *Richard Nilsen*
The Preservation of Old Buildings *Wendell Berry*
Energy Stories *Steve Baer*
Nitinol: Torque of the Town *Fred Gardner*
One Highly-Evolved Tool Box *J. Baldwin*
Zen Pants, Fat Pants *Paul Reps and Annie Leibovitz*
Jerusalem: Innerviews *S.N. Durkee*
Jack and the Monster *Gurney Norman*
"Furthur" to the Smithsonian *Stewart Brand*
South of the Slot *Dan O'Neill*
Sesshin Lecture *Zentatsu Baker-Roshi*
The Posthumous Journey of the Soul — Myth & Science *Stanislav Grof, M.D. and Joan Halifax-Grof, Ph.D.*
New Swimming *Rosemary Menninger*

No. 6, Summer, 1975

What Do We Use for Lifeboats When the Ship Goes Down? *my*
Living on a Lifeboat *Garrett Hardin*
Holiday for Cynics *Dan O'Neill*
Three From Space *Carl Sagan*
The Atmosphere as Circulatory System of the Biosphere — The Gaia Hypothesis *Lynn Margulis and James E. Lovelock*
Who's Earth *Russell Schweickart*
Introducing Margalef *Stewart Brand, Peter Warshall, Michael McClure*
Perspectives in Ecological Theory *Ramon Margalef*
Dude Farms *Sally Nicholson*
Seed Clouds, Reap Havoc *Patrick Porgens and James R. Bukey*
Sinsemilla Marijuana *Otto Peep*
Making Stone Arrowheads & Scrapers *Gil Verde*
Condoms, These Days *Salli Rasberry and Laird Sutton*
Homing Pigeons *William L. Cassidy*
Jack and His Ego *Gurney Norman*
Relative Poverty and Frugality *Paolo Soleri*
"Reality" and Redundancy *Gregory Bateson*
The Human Use of Inhuman Machines *Dave Caulkins*
The Nature of the Beast *Marc Le Brun*
Advice for the Computer-Lorn, or, Getting Yourself a Computer *Dick Rubenstein*
Evaluating Computers for Home or Personal Use *Dick Rubenstein*
The Structure of Mystical Experience *Brother David Steindl-Rast*
Ritual . . . As Communication and as State *Roy A. Rappaport*
Blessing Way Ceremony, Puberty Rite *Maud Oakes*

No. 7, Fall, 1975

The High Frontier *Gerard O'Neill*
Testimony *Gerard O'Neill*
"Is the surface of a planet really the right place for an expanding technological civilization?" *interviewing Gerard O'Neill*
Deep Space Material Sources *Eric Drexler*
Caring and Clarity *conversation with Gregory Bateson and Edmund G. Brown, Governor of California*
In the Beginning God Created the Banana *Dan O'Neill*
The Difference Between Unity and Uniformity *E.F. Schumacher*
Schumacher's Buddhism *Peter Gillingham*
Systems, Economics, & "Female" *Hazel Henderson*
The Garden *Jay Kinney*
Acres, U.S.A. Conference *Richard Nilsen*
Advanced Wood-Burning *Doug Dylla*
Working in China *Orville Schell*
From Field Guide to Western Oregon *David Shetzline*
Gay Access *Richard Hall and Dan Allen*
True Representation *Michael Phillips*
The Reactive Engine Paper *Terry Winograd*
System Incoherence *Marc Le Brun*
From the Command Center: The Mayaguez Incident *Brigadier General Donald Sampson on the phone*
The Gathering Challenge to Fiat Money *Carter Henderson*

No. 8, Winter, 1975

Local Dependency *Stewart Brand*
The Clothesline Paradox *Steve Baer*
The Briarpatch Network *Andy Alpine*
What's Left? Revisiting the Revolution *Jay Kinney*
The Ohu Movement in New Zealand *Elliott Smith*
Nonviolent Direct Action is Alive and Well in Europe *Lee Swenson*
Finding Our Place in Space *Gordon Ashby*
Poems *Richard Brautigan*
A Guide to Buying Horse Equipment *Jack Carroll*
Marlon Brando Plans a Whole Earth TV Special *conversation with J. Baldwin and Stewart Brand*
Raw Food — Recipes from the Tropics *Alicia Bay Laurel*
Where Did All the Communes Go? *Bill Wheeler*
Confessions of an Ex-Blackjack Player *Rolf Cahn*
An Interview with Two Serious Young Gamblers *Rosemary Menninger and Marcia McCree*
A Capsule View of the Biosphere *interview by Salli Rasberry*
Homestead Bicycle Technology *Jim Burgel*
Round Spinning Vehicles *Herald Reno Hoyt*
Odd Bodkins *Dan O'Neill*
Access to Synthesizers *J.D. Sharp and Mark Garetz*
African Drumming Kit *Craig Woodson*
Herbal Solutions to the Simple Earache *Jeanne Rose*
The Further Adventures of Huckleberry Finn *Baine Kerr*
Guide for the Lost Plant Taxonomist *Pamela Hartman De Alth*
A Brief Memoir *Anne Waldman*
Ancient Creek *Gurney Norman*
Interview with a Cattle Mutilator *Paul Krassner*
Sporting Deaths *Russell D. Chatham*
The Optimist *Don Carpenter*
Running on Empty *Johnny Popper*
An Abridged Collection of Interdisciplinary Laws *Conrad Schneiker*
The Joy of Socks *Tom Jester*

Farallones Institute

"Where can I go to learn about soft technology?"

That's the commonest question I get at colleges and such places. My answer increasingly is Farallones. Its program is both practical and widely integrated – solar, wind, advanced compost, waste water, construction, gardening, livestock, and urban and rural applications. Teachers include CQ*'s soft tech editor J. Baldwin. The president of Farallones, Sim Van der Ryn, was recently appointed State Architect by Governor Brown, which adds a dimension.*

–SB

Farallones Institute

Tuition: **$750**/10-week session
(**$1000** for college credit)
Catalog: **$1**

from:
Farallones Institute
15290 Coleman Valley Rd.
Occidental, CA 95465

Display wattmeter

DEAR CQ,

ISN'T IT TOO BAD THAT THE UTILITY COMPANIES' WATTMETER IS STUCK WAY OUTSIDE ON THE BACK WALL?

WOULDN'T IT BE GREAT IF WE ALL HAD ANOTHER NEATLY PACKAGED LITTLE METER HUNG IN A CENTRAL PART OF THE HOUSE?

DIGITAL READOUT?

CULTIVATE A REAL FEEL FOR THE JUICE YOU USE ...

"JESUS WHAT DID YOU JUST TURN ON, WE JUMPED A THOUSAND WATTS?"

NOT JUST A BILL AT THE END OF THE MONTH BUT A BIG GLARING NUMBER THAT RISES OR FALLS WITH THE FLICK OF A SWITCH. 10 LIGHTS EQUAL 1 TOASTER EQUALS 1 TV AND 2 FANS ETC...

AND JUST WAIT TILL SOMEBODY KICKS IN THE AIR CONDITIONERS...

TOM PARKER

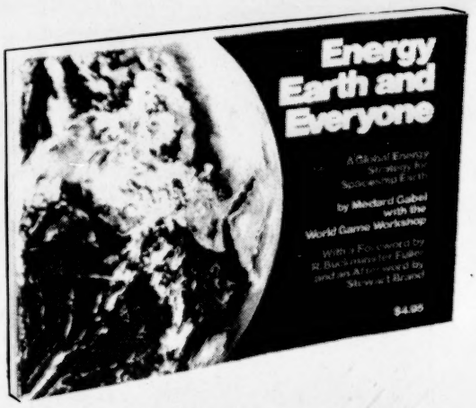
Energy Earth and Everyone

At last available as a "real book," it's been updated and graphic-arted upon so that the excellent and useful contents are easier to get at. This book is very different from any other energy book we know of, in that it not only explains, but quantifies and prescribes. If energy is your interest, you really should have one of these at hand. Especially at the commendably low price asked. A major portion of the book was printed in the Spring '75 CQ.

–J. Baldwin

Energy Earth and Everyone
Medard Gabel and the World Game Workshop
1975; 160pp.
$4.95 postpaid

from:
Simon and Schuster
One W. 39th St.
New York, NY 10018
Attn. Order Dept.
or Whole Earth



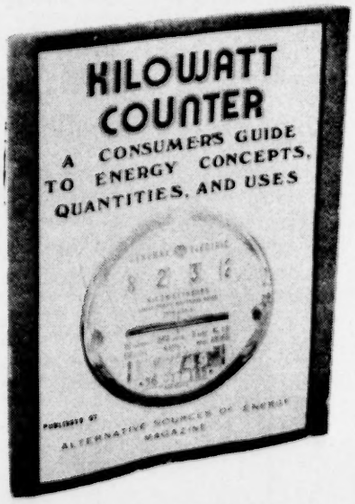
Kilowatt Counter

A publication by Alternative Sources of Energy magazine and the Institute for Local Self Reliance, just loaded with those facts you need to make decisions and win arguments. It's commendably unemotional in contrast with some of its competition, and the indictment of waste is unmistakable. The layout encourages use of the book by teachers. Good; there's a lot to learn here.

–J. Baldwin

Kilowatt Counter
Gil Friend and David Morris
1975; 36pp.
$2.00 postpaid

from:
Alternative Sources of Energy
Rt. 2, Box 90A
Milaca, MN 56353



33. If we use energy equivalents of Calories expended and BTUs in a gallon of gasoline, how many miles does a bicyclist get per gallon?

a. 15 mpg
b. 400 mpg
c. 1,100 mpg

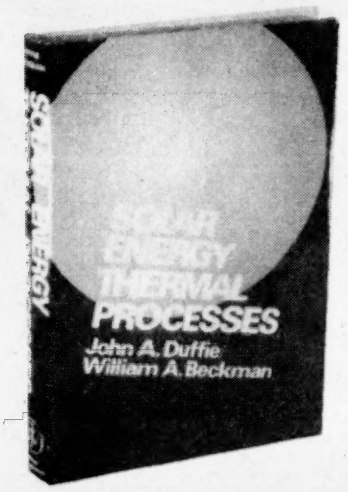
(For answer see below)

33. c. 1,100 mpg. A non-athletic person of about 150 lbs. can manage to leisurely maintain a speed of 11 mph on a 30 pound 10-speed for an extended period of time. This person will need to add about 1500 Calories to his diet for each five hours he cycles, or about 300 Calories per hour. One gallon of gasoline equals about 30,000 Calories. Therefore, a bicyclist can travel 100 hours (30,000/300) on one "gallon." 100 hrs/gal x 11 mi/hr = 1,100 miles per gallon.

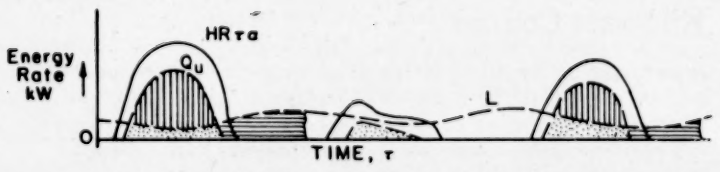
Solar Energy Thermal Processes

Dilettantes stand aside! This one is for the trained engineer/scientist interested in sharp performance and cost analysis of solar heating and cooling systems. The basic theory is presented in great detail, but the practice concentrates on flat plate hardware, with a bit on focussing devices. Storage and system-modeling are also discussed thoroughly. Unfamiliar, unusual and innovative designs are given short takes only, but the book will fill a long felt need in architect's offices getting into solar work.

—J. Baldwin



Solar Energy Thermal Processes
John A. Duffie and William A. Beckman
1974; 386pp.
$16.95 postpaid
from:
John Wiley & Sons, Inc.
One Wiley Drive
Somerset, NJ 08873
or Whole Earth



A hypothetical solar energy process with storage. Absorbed solar energy, HRta, collector useful gain, Q_u and loads, L as a function of time for a 3-day period. Vertical shaded areas show times of excess energy to be added to storage. Horizontal shaded areas show energy withdrawn from storage to meet loads. Dotted areas show energy supplied to load from collector during collector operation.

Solar Energy Handbook

A small but tightly packed collection of the numbers, conversions, equivalents and definitions needed by a serious experimenter. This booklet may well establish itself as the standard solar reference.

—J. Baldwin

Solar Energy Handbook
Paul A. Fleck, Editor
1975; 92pp
$4.45 postpaid
from:
Time-Wise Publications
P.O. Box 4140
Pasadena, CA 91106
or Whole Earth

POWER UNITS

1 Btu/min =	5.260×10^{-13}	Q/yr	1 Q/yr =	1.901×10^{12}	Btu/min
	1.758×10^{-2}	kw		3.343×10^{10}	kw
	1.758×10^{-5}	Mw		3.343×10^{7}	Mw
	2.358×10^{-2}	hp		4.484×10^{10}	hp

HEATING VALUES

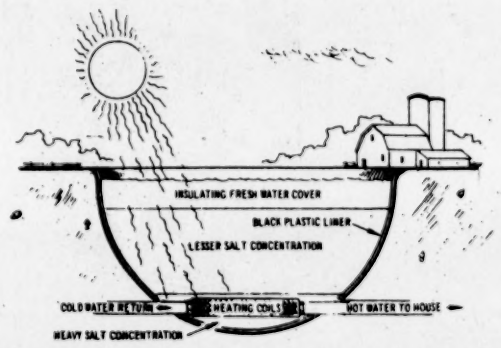
1 barrel crude (b) (42 gal/b)	= 5.8×10^{6}	Btu*
1 ft^3 natural gas (cf)	= 1.0×10^{3}	Btu*
1 ton coal (tC)	= 2.6×10^{7}	Btu*

Solar Pond

One of the most promising recent discoveries is that a 9 ft. deep pond filled with dense brine at the bottom can collect and store a useful number of BTU which can be rather easily recovered and used. It seems that the brine keeps the heat on the bottom of the pond instead of the expected heat-rises bit. The scheme is particularly well suited to serving several structures, as there are economies in larger sizes. Watch media for further developments, or you could try writing the experimenters. Be sure to enclose a stamped self-addressed envelope, and bear in mind that they're busy and might not answer.

—J. Baldwin
[Suggested by E.J. Miller]

Solar Ponds
Being developed by:
Prof. Carl E. Nielsen, Ohio State University
1659 N. High St., Columbus, OH 43210

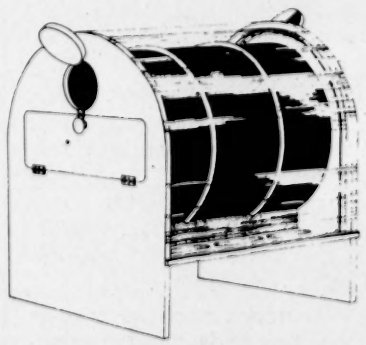


This diagram shows the operation of a solar pond. Temperatures of 158 degrees have been measured in a natural Hungarian solar pond. And experimental ponds have attained temperatures of 194 degrees.

Solar Energized Food Dehydrator

Most of the really useful solar hardware is coming from small outfits. There seems to be a distinct aversion by big companies to get into a business where they can't sell or control the monopolistically critical components. (hee hee) Anyway, here's a nifty set of plans that seem to be well thought out. At the very least, they'll get you started on experiments of your own. These are very clear and nicely drawn. Most other plan-sellers, please take note.

—J. Baldwin



Solar Energized Food Dehydrator
Plans: **$5.00** postpaid
Complete unit:
$200.00 F.O.B.
from:
Solar Survival
Cherry Hill Rd.
Harrisville, NH 03450

Solar Test Facility

A set of racks and associated measuring equipment into which you can plug your design and see how it does under controlled conditions, including racing it against others. The men who run the place are "real" scientists and engineers, so the results should tell you something useful.

—J. Baldwin

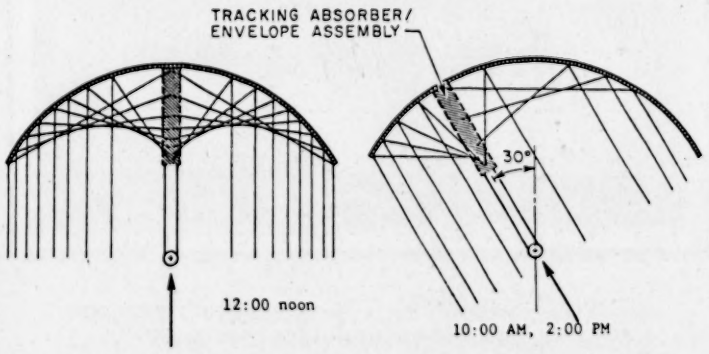
For more information, contact:
Harold Connell
Manager, Instrumentation Div.
Physical Science Laboratory
New Mexico State University
Box 3548
Las Cruces, NM 88003

Solar Directory

A comprehensive (to say the least) directory of people, organizations, manufacturers, educational institutions, researchers, projects, and damn near everything else you could think of that pertains to solar energy. Not much on plot, but the characters are all there in fine detail.

—J. Baldwin

Solar Directory
Carolyn Pesko
1975; 622pp.
$20.00 postpaid
from:
Ann Arbor Science
Publishers Inc.
P.O. Box 1425
Ann Arbor, MI 48106



VW prime mover

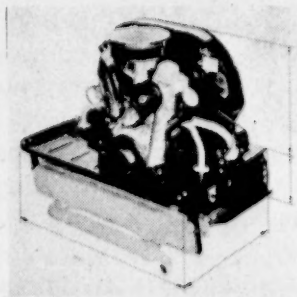
This company can help you put that old bug engine to work as a reliable and efficient stationary power source for driving irrigation pumps, compressors or a host of equipment. Upon request, they will send product data sheets for conversion accessories such as a universal bell housing, direct drive, pump drives, T-box (on special request), a universal clutch housing, double or single shaft reduction gears, drive plates, spline shafts, etc. They also sell 40 and 53 hp VW engines modified slightly for stationary use. Ask for a price sheet.

They provide specifications and also graphs of power output versus RPM, torque versus RPM and fuel consumption versus RPM for both engines (handy to have).

You might want to consider using methane or fuel/alcohol as an alternative or backup to gasoline.

—Bill Hutchinson E.S.I.
Arlington, Texas

Type 122 & 126A
VW Industrial Engine
& Accessories
Information free
from:
Industrial Engine Division
Volkswagen of America, Inc.
North Central Region
3737 Lake Cook Road
Deerfield, IL 60015



Devcon

One way to conserve energy and resources is to fix things that break rather than throwing them away. The Devcon Corporation makes a wide variety of products that can solve some very nasty repair problems as well as increasing the life of various hardware. Typical is Plastic Steel and Plastic Aluminum. A far cry from their sissy hardware store counterparts, they are super strong and you can (for instance) repair engine blocks. They make a paint called "Z" that actually outperforms hot dip galvanizing (Milspec no less). Their Devcon Rubber repairs split rubber boots better than anything else I've seen. They make a wear resistant self-lubricating epoxy compound that can be used to make long wearing bearing surfaces in wood. (It can also be used to build up worn shafts.) The list goes on. I've used all this stuff and find it to be at least as good as they say. Not many companies are worthy these days. This one is. You'll probably have to get their products from an industrial supply house. The catalog is available there too.

—J. Baldwin

Devcon Corporation
Danvers, MA 01923

Devcon Ltd.
Theale, Berks., England

Devcon Canada Ltd.
Scarborough, Ontario, Canada

Devcon De Mexico, S.A.
Mexico, 5, D.F.

Devcon Z — The Zinc Rich Coating. Contains 95% pure zinc and 5% epoxy binders (weighs 24 lbs. per gallon). Approved by Underwriters' Laboratories as equal to hot dip galvanizing. Used on large metal tanks, towers, buildings, ships, fencing, railings, etc. Stops rust and rust creepage by galvanic action. Unlike red lead and other "sealing" paints, it protects surface by galvanic action even when coating has been scratched. Meets or exceeds U.S. Navy Specification MIL-P-21035 (ships), Galvanizing Repair; U.S. Air Force Specifications and others. "Cold galvanize" material may be applied by brush, dip, spray or roller. Devcon Z thinner available if dipping or spraying is desired. 1½, 6, 24 lb. packs (24 lbs.= 1 gal.). Also supplied in 16 oz. aerosol can. Thinner: 1 qt., 1 gal.

The Procedure Handbook of Arc Welding

As a welder in a large plant using many different welding processes every day, I have found this to be the most comprehensive and current book on arc welding going.

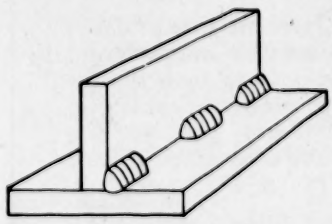
Reliable information on all arc processes (stick, innershield, submerged, electro-slag, MIG, TIG), weldability of metals (carbon and stainless steels, aluminum, cast iron, copper) including sheet metals, with special sections on design, machinery, testing and qualification procedures, pipe and out-of-position techniques, distortion control, underwater welding, arc-gouging, galvanized and concrete re-bar welding, and hardsurfacing. All clearly explained with plenty of photos and diagrams, tables and graphs.

Really an eye-opener into the welding field; information valuable to the worker in a large metal fabrication plant as well as the farm welder and small shop. First printed in 1933 it is currently in its 12th edition, updated last in 1973.

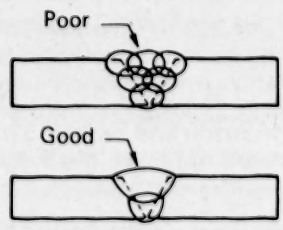
Their mail service is prompt (I received my copy in about 2 weeks, their catalog arrived within 4 days) and at a fair price too. They also have learning manuals available plus some excellent volumes on welded structures throughout the world.

—Steve Keleher

The Procedure Handbook of Arc Welding
1973; 700pp.
$5.00 postpaid
from:
The Lincoln Electric Co.
22801 St. Clair Ave.
Cleveland, OH 44117



Intermittent Welding



Minimum Number of Passes

MORE

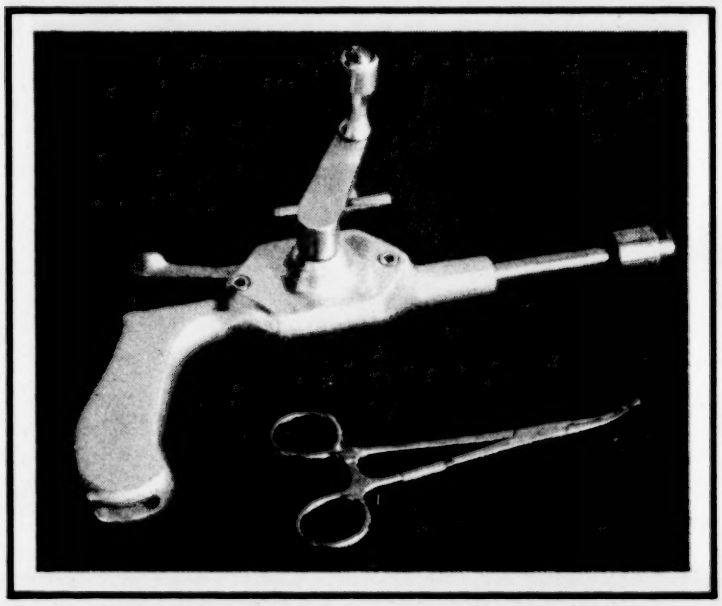
Highly-Evolved Toolbox

BY J. BALDWIN

In the Spring '75 **CQ** I tried to establish some reasons for buying good quality tools and keeping them neatly in a big mechanic's cabinet. I also floated out the idea that it can be useful to regard tools as extensions of your hands.

It's obvious how they are extensions of your hands. A hammer is just a hard fist; a screwdriver, a tough fingernail. But hands usually operate according to instructions from head, so it can also be said that tools are an extension of your mind. Looked at this way, the big (expensive) mechanic's cabinet with all the tools of similar function stored together with high visibility becomes even easier to justify. I find it is effective to store the tools by function rather than by name because this is the most useful way to think of the best tool when you are selecting. Hitters, grabbers, slashers, abraders — regardless of what they are called, are there in their places. You take your pick. Often, just looking at them will give you a better idea not only of what tool to use, but how to do the job or how to design the object. That's a big advantage of the neat toolbox. If the tools are "somewhere out on the back porch or maybe in the back seat of the VW" then your mind is deflected from creative thinking into a hunting mode, and the aggravation can easily cause you to lose your ability to get things done.

Easily accessible, functionally sorted tools also give you a ready familiarity with the tools you have. This has two effects. First is that as you get to know your tools, you gain the easy fluid motions that go with using them. You're not afraid of them any more, though respect is increased. This makes you able to work faster with less fatigue just as good form in sports often makes a big difference. It makes you safer too. Safety is also enhanced by having the tools



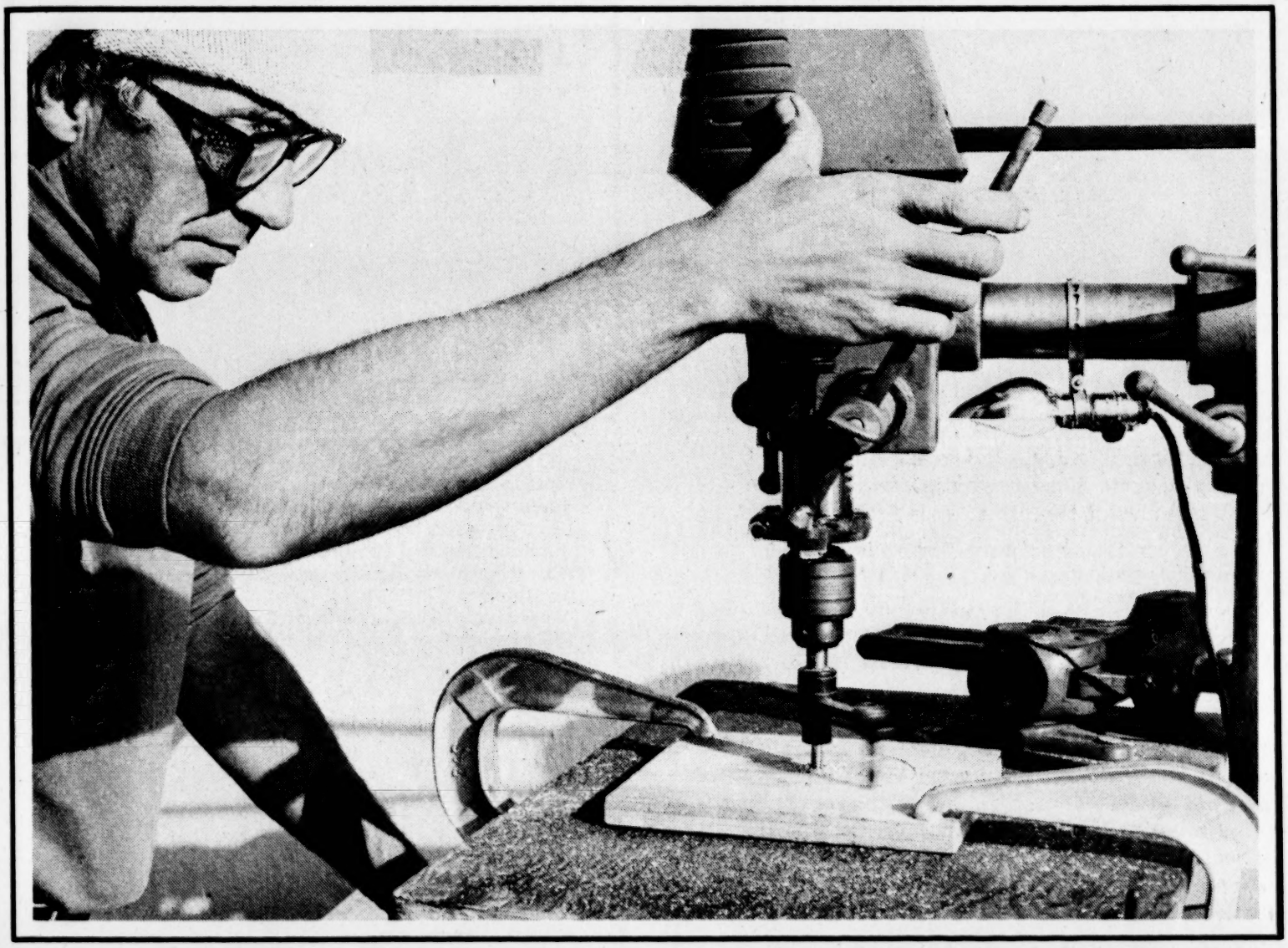
SURPLUS SURGICAL TOOLS are often ergonomically excellent and are useful for precise work. Bone surgeon's drill and this hemostat aren't really absolutely necessary in your shop, but are very satisfying to use. (Hemostat from Brookstone, CATALOG, p. 142.)

where you can easily inspect them for condition, sharpness and rust. We have found that safety is largely a matter of attitude. The closer tools are to being a working extension of your mind, the safer you'll be. Self-preservation.

The second effect is that you get to "know" all the tools you own without having to consciously think about it. This makes it simple to round up strays, of course, and it's easier to see where there are annoying gaps in your capabilities ("we don't have a lightweight mallet"). More importantly, you begin to think in terms of the tools you have. The eventual result is that you and your entire toolbox and shop become a big, complex tool with many possibilities. You begin to sense what you can do together. Buying tools with overall flexibility of purpose in mind, as I recommended in the Spring **CQ**, keeps you from falling into the trap of building a one-function capability with accompanying tendency to conservatively fossilize your creativity. This tendency is strengthened as a value of the tools

"One Highly-Evolved Toolbox" was the title of J.'s first essay on tool use. It specified THE most useful, hardy, multi-purpose, and often unusual tools that had made themselves indispensible to his life of constant invention and repair. This second essay goes into integrated function, the intelligent use of intelligent tools.

—SB



HOLE CUTTER making piston discs. I have a small town phonebook in my shirt just in case something lets go. I've picked metal out of it twice. It doesn't take a Ph.D. thesis to tell you that certain tools require a certain caution. Be extra careful as you go through the super-cool, smarty-pants phase of tool familiarity. Except for rare freak accidents, few tools will cut things that you don't deliberately feed them.

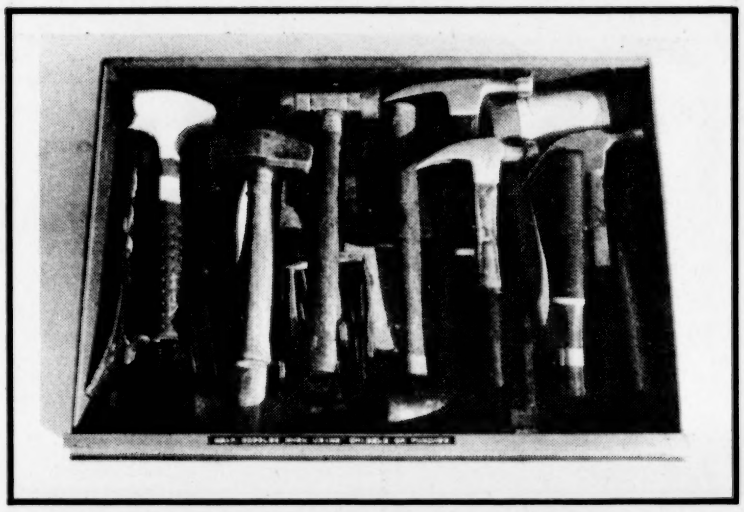
---

rises, which is the main reason society doesn't get fast response to its changing needs from large corporations who have sunk enormous capital into shops that make that only. Like fat cars. Once in that position, it's difficult to evolve at all, let alone without damage or drastic change of form.

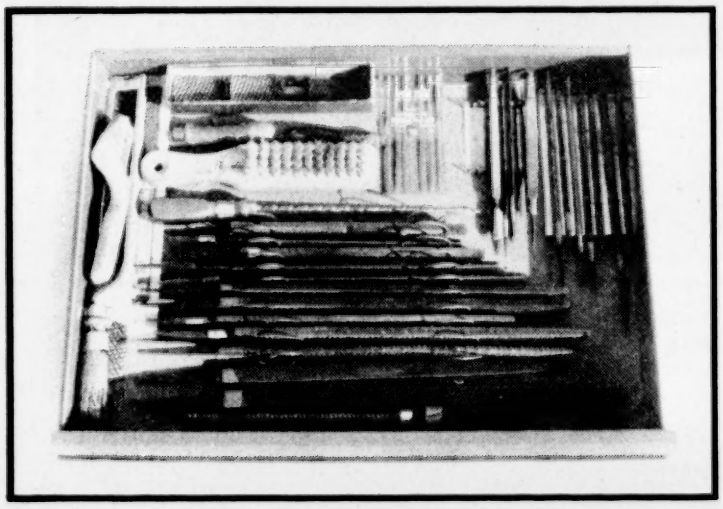
So you begin to build your tool capability into the way you think about making things. As anyone who makes lots of stuff will tell you, the tools soon become sort of an automatic part of the design process. Beginners worry too much about skill and safety, rather like new drivers worry most about jerking the clutch when learning to drive a stick shift. It doesn't take long before more serious aspects take over, and the manipulation problems fade out. But tools can't become part of your design process if you don't know what is available and what the various tools do. In addition to buying tools that I find useful, I spend some time reading catalogs so as to become familiar with tools that I can't afford or don't need at the time. Tool catalogs such as Silvo (CATALOG p. 140) are rather like my cabinet in appearance so I find it painless to sort of automatically file the information away in the back room somewhere. Tool dictionaries, especially of older tools, are helpful too. (See p. 105 this issue.)

Some of you are saying about now, "Who wants to get into it that far anyway?" Friends, there are advantages. Obviously, making or repairing things yourself can save you money and time. Well, maybe it isn't so obvious. Example: next time your car breaks down, find out how many hours it will likely take to fix it. You don't have the time, right? OK, how many hours will you have to work at some job so you can pay that mechanic? For many of you, the hours you have to work to pay the mechanic will be more than the job would take if you did it yourself. Moreover, you don't have to pay yourself, and the job can be done to your standards and at your convenience. If you don't have the skills or the tools, that's what we're talking about! Doing it yourself can free you from certain dependencies

SIMPLE JIG holds each 2 x 4 inserted for drilling in the same relative grip, and so each will have its hold in the same place. Be sure and blow out chips so part will fit snugly, and always mark jigs so you can detect if they are slowly moving as parts thump into place. CLAMPS are a good thing to have lots of.



HITTERS. Wood handled hand sledge has been replaced by more reliable and better-balanced Estwing model. I'll give the old one away to a friend who has none and doesn't mind replacing the handle again. Our big sledgehammer lives with "outdoor" tools hanging on the wall. Third hammer from left is a BB-filled "no-bounce," really great for sheet metal and chisel work. (Brookstone)



ABRADER DEPARTMENT. Spring keeps files separate so you can see them, and also keeps files from filing each other. Drawer lining is indoor-outdoor carpet.

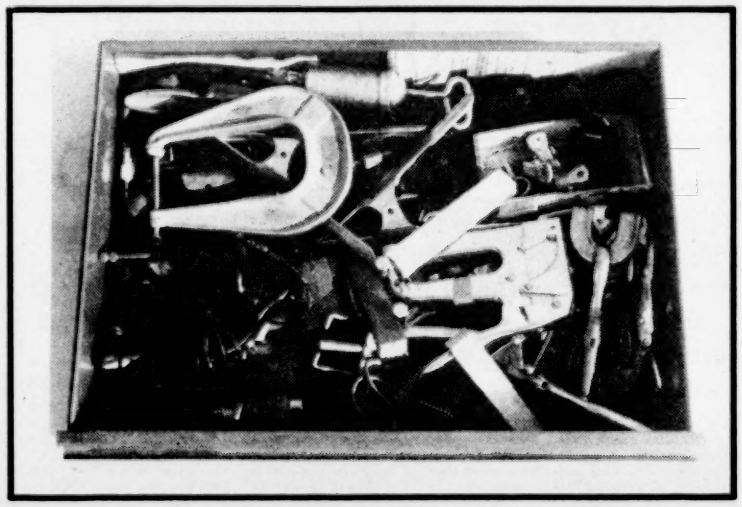
HOLE-MAKING DEPARTMENT gets heaviest use, partly because the rotary devices are so versatile in other modes. Assortment of hand drills is because we often work where there is no power available. Their lair is rather deep for a photo, so I've had them sit on the step for a class portrait.

---

that you may find smothering. What if the $20.00/hour plumber can't come until next Friday? Repairing pipes is relatively easy. Once you learn how, you not only avoid being at someone's mercy, you have a skill that can help friends or make money for you. How-to books are tools, in case you haven't guessed.

Another advantage of having some tools that you know how to use, is that as you get an easy, facile familiarity using them, you begin to get a better feel of the ergonomics of other techno-hardware that you use or make. (Ergonomics is the man-machine interface; how the steering wheel feels in the hand and how it tells you what's happening to the wheels; the wrist-breaking poor feel of eggbeaters; the built-into-you feel of a good rifle). Poor ergonomics is one of the main reasons behind the recent public disenchantment with technology. Things are made with the convenience of the machine in mind instead of the human user. The result is hardware that is hard to hold, too cold or too hot, difficult to repair, easy to lose or lose control of, easily broken, etc., etc., etc. The machine is in control of you instead of the other way around. You can do better, yes? Most highly evolved good quality tools are ergonomically good. (Rifles are tools. You peacable types can put down your neck hairs, it was only an example.) So without having to take a course in the subject, you can gain an informed feel of what is satisfying. As with most problems brought to us by technology,

As an example of good ergonomics, a SAWYER CANOE PADDLE is hard to beat. It feels right and looks right. The ultra light weight (1¼ lbs) saves you from lifting about a full ton on the return stroke during a typical day's paddling, and also enables you to use the power of the wider-than-usual blade design. (From Recreation Equipment Inc., CATALOG, p. 266.)



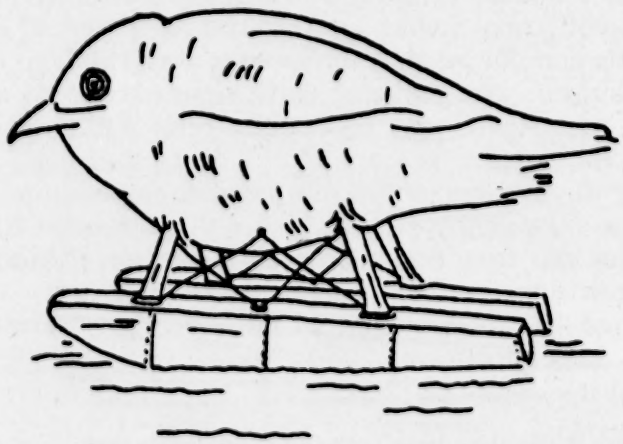
ASSORTED UNSORTABLE DEPARTMENT.
You didn't really think that there was a way around having one of these did you? Nobody, including me, knows what's in here.

ergonomic problems are often best solved not with more technology but with clear thought and a better-informed intuition.

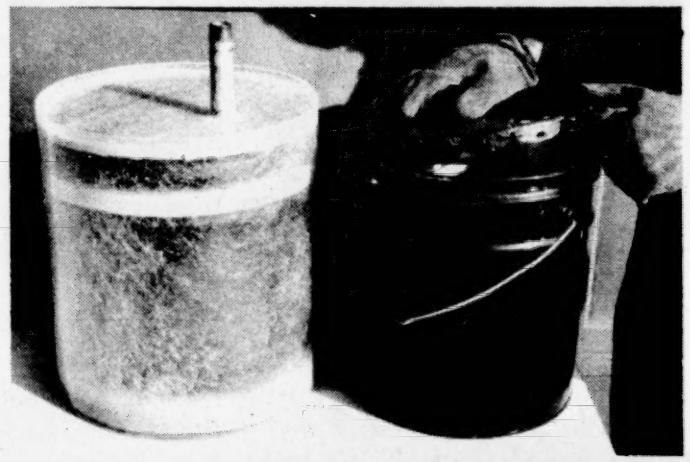
An informed tool intuition works best if it's augmented by an informed materials and processes intuition. For instance, if you don't know anything about foundry work (casting), it's unlikely that you will come up with ideas that require it. Often, this ignorance (ignore-ance) is easily remedied. A bit of inquiry may well show that what you had considered a black art is actually not one at all. Bronze and aluminum castings, for instance, are made every day in high school art departments by unskilled students using scrap metals from auto wrecking yards. Anyway, things take a form dictated by the possibilities inherent in the material to be used and the tools that can shape it, and the ideas in the head of the worker. It follows that the more you read, and snoop around and experiment and practice, the easier it will all come and the more independent you can be. Freedom rising.

The ultimate is to make your own tools. Tools fitted intimately to you by you. What could be niftier? Blacksmiths are really into that. A good example is found in the books by Alexander Weygers (EPILOG p. 548). But tools need not be limited to the shop. How about making your own personal canoe paddle? Or your own left-handed kitchen equipment? You can modify existing tools too. For instance, when we needed to make 7-inch diameter pistons for a small production run of giant raft-inflating hand pumps, we reversed the bit in a hole cutter so it made discs instead. The pistons were then easily and accurately cut from heavy plywood with a great saving in time and material compared to turning them on a lathe that we would have had to borrow. Making the big pump's leather "piston ring" seals proved to be easy after we spent some time talking to craftsmen in a sandal shop. With their advice, we soaked heavy leather discs in Mink Oil and then pressed them into the desired shape with a matched male and female die rammed by our vise. The dies were made on a bandsaw modified with a simple homemade attachment that enabled us to cut bevelled round holes with good accuracy. That attachment was also used to make the next batch of pistons, as it proved faster than the disc-maker on the drill press. Tools making tools making tools.

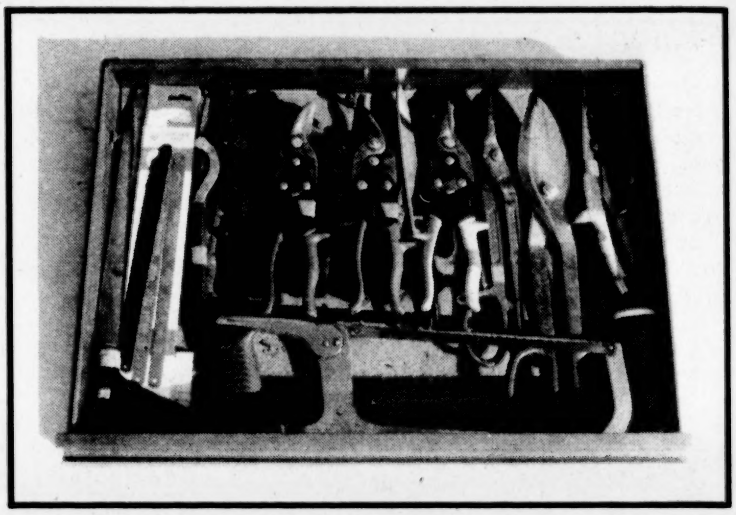
I can hear some of you saying "small production run! Yuk. . ." Unless you are an artist, and maybe even then, you will sooner or later need a bunch of things all alike. Even with only the most basic tools, you can mass-produce things. The precision and complexity of the produced parts is somewhat dependent upon the adaptability and quality of your tool bank, another reason to intelligently gather good stuff. Large scale mass-production tends to



Philip Garner



To test several schemes for a SOLAR HOT WATER HEATER, we're making up a number of identical new 5-gallon cans and covering them with a variety of heat-retaining skins. Then we'll race them. To have these made for us would not only be horrifyingly expensive, but we'd lose the experience gained by actually working with the various materials that we will be specifying eventually. To have another person make experimental equipment is often analogous to a painter verbally giving directions to a hired hand who wields the palette and brushes. You lose control, and dilute the idea before it has a chance to mature. And sometimes, your best ideas will come to you as you manipulate things yourself.



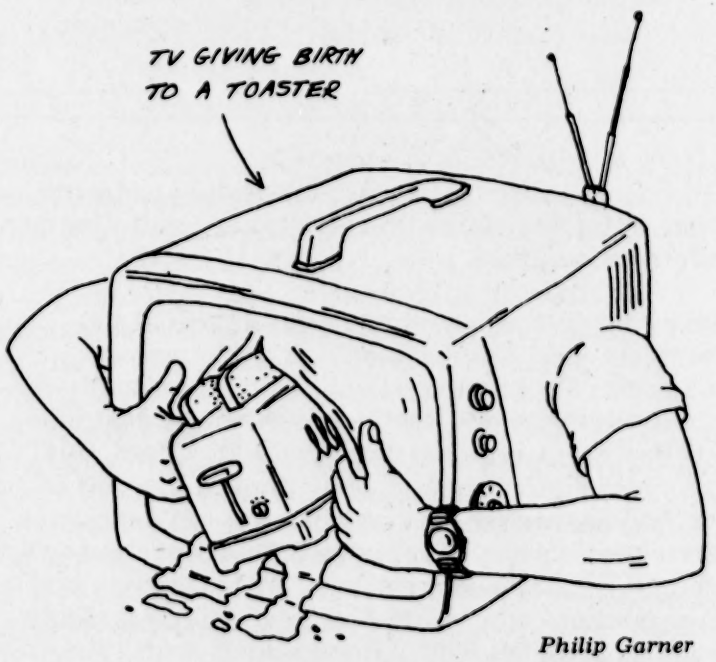
SAWS AND SNIPS DEPT. Don't get hung up on tool names. "Tin snips" can cut lots of other things such as leather. The three identical-looking guys are "aircraft snips" and they aren't identical at all. The yellow handled ones cut straight; the green handled ones cut righthanded circles or curves and are just the thing for lefthanded people; the redhandled ones cut left as you might expect. Lever action makes it all easier. The contoured grips help too. Gloves should be worn while using these. It helps you apply power without pain, and prevents the dreaded sheetmetal cuts, which are like paper cuts only worse. Mock it up in cardboard first.

enslave both the workers and the customers. The workers are used as if they were machines. The huge capital outlay for the factory means that there must be a huge and relatively steady demand. This in turn means heavy manipulation of public "desires" and almost always involves politics and coercion.

Small scale production, though, can mean a great reduction in drudgery as well as interesting possibilities in barter. By means of jigs and other simple fixtures that you can figure out yourself, you can be freed from having to measure each part. Hold the piece of wood against the jig and hit it with the drill and all the holes will be in exactly the same place in each part.

We've mass-produced thousands of dome struts and parts for conventional construction. We've also produced simple looms and the aforementioned pumps (which we bartered for a fleet of rafts and got into the whitewater river running business), solar collector parts, signs (during an anti-freeway fight), toys, boxes, electronic parts, concrete forms, fence rails, adobe blocks, tents, shelving, lighting systems, and model parts, to name but a few. The ability to get on a small production run frees you from dependence on larger less efficient manufacturers, their prices, specifications and schedules. It can be rather fun, too, if it doesn't go on for too long. "Shop Yoga," we sometimes call it.

And it can be done without sophisiticated expensive equipment if you take the time to think it all out first. The thinking is the most powerful part. You can actually change some things out there! Maybe not in a big way, but certainly at a scale that you can understand. You will find that as you work, your understanding of technology will increase a bit, and your fears based on ignorance will decrease. (Your fears based on newfound understanding might well increase, but that's another paper.) In a modest way, you can combat the "machines taking over" by having better control of the technology you live with. It's a good feeling. And it's free. ■

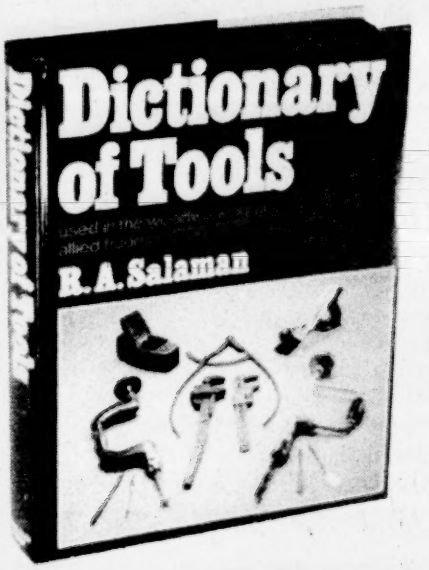


Philip Garner

Dictionary of Tools

Tool freaks, this is the ultimate tool book! Not only an incredible array of woodworking tools from past and present shown, but plenty of special-purpose (e.g., wheelwrighting) ones, too. The extra clear illustrations often show the tool in action, which should enable you let's-do-it-the-old-way people to get at it. There are diagrams of such things as coaches, barrels, farm wagon undercarriages, Dutch windmills, and the like. All wood. This adds up to a book that is much more than a museum display of artifacts. It is, in my opinion, worth the money which is a special deal by the importer. Perhaps you can talk your library into it, but serious workers will want one of their own. Yummy!

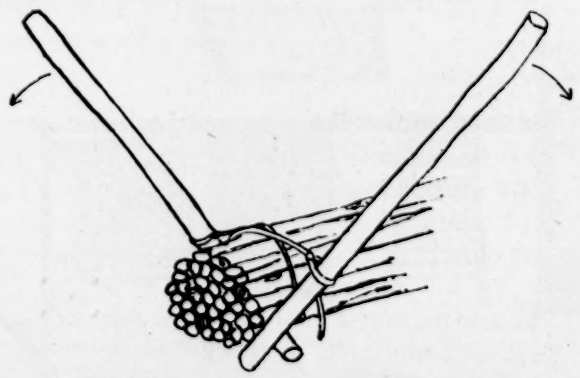
—J. Baldwin
[Suggested by Jonathan Katz]



Dictionary of Tools
R.A. Salaman
1975; 545pp.
$47.00 postpaid
from:
Woodcraft Supply Corp.
313 Montvale Ave.
Woburn, MA 01801

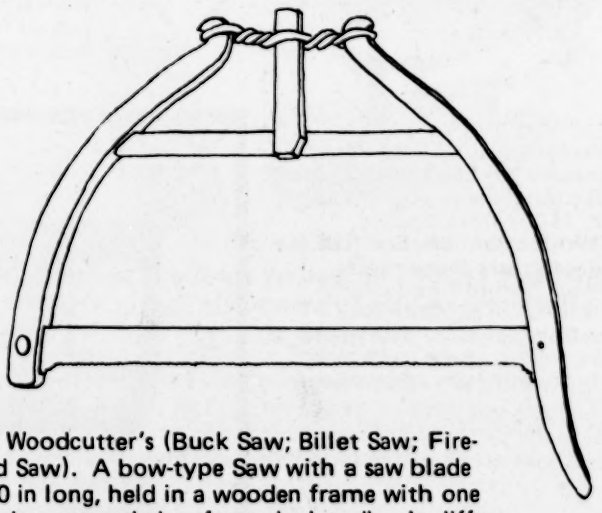
Carrying Stick (Carrying Cane; Frail Stick) A crooked or S-shaped stick, often cut from the hedge. One end of the crook lies on the shoulder, the other forms a handle. It is used for carrying a bag of tools, and a wooden pin is set near the end to prevent the bag from slipping off.

•



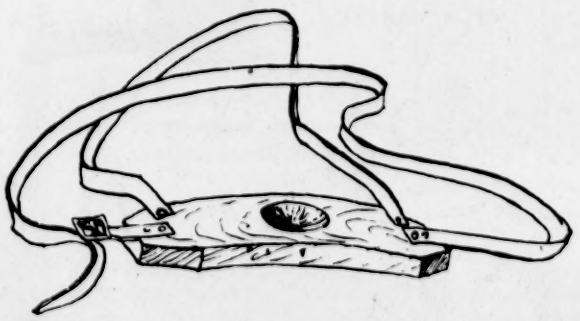
Woodman's Grip. Two strong poles, about 3 ft 6 in long, connected by a length of rope at a point about a foot from the lower end. Its purpose is to compress rods and stakes into bundles for tying up before carting away.

•



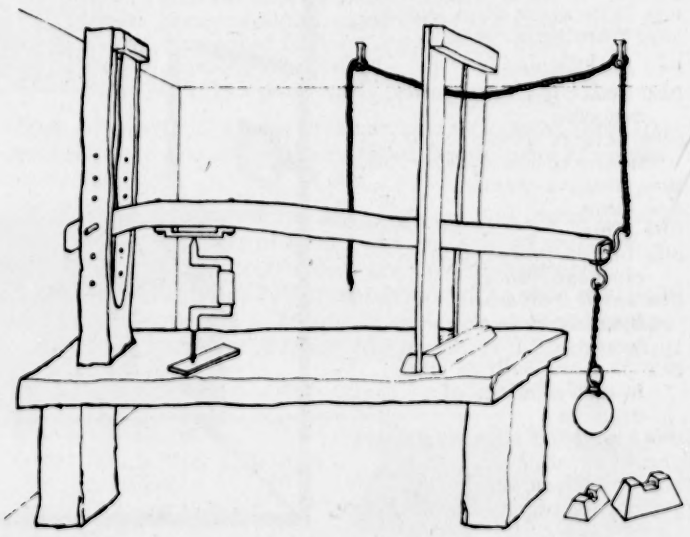
Saw, Woodcutter's (Buck Saw; Billet Saw; Firewood Saw). A bow-type Saw with a saw blade 24-30 in long, held in a wooden frame with one side-piece extended to form the handle. It differs from the usual Bow Saw in having a rigid blade which cannot be turned, for it is intended for cross-cutting firewood, etc. Mercer (U.S.A., 1929) writes that 'it is still used among farmers etc who grease the blade with a piece of hog fat, kept hung on a nail in the wood shed'.

•



The Breast Bib. A piece of hardwood shaped to the chest and secured by a light leather harness. It has a recess on the front surface in which the head of the Brace is held. Its purpose was to distribute the pressure exerted by the head of the Brace over the area of the chest; and by locating the head of the Brace, it helped to steer it accurately at the right angle. Sometimes Breast Bibs are found with a groove across the recess on the front. This is where the Chairmaker used his chest, protected by the Bib, as a cramp to force parts of a chair together.

•



By Shaker Hands

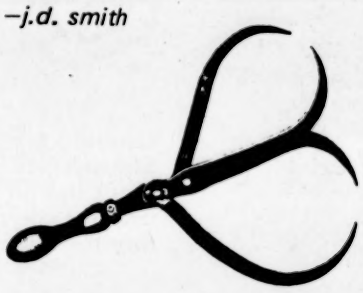
I have been an admirer and kindergarten student of Shaker furniture for several years, trying somehow to make my hands perform acts of simple beauty while my head was still in the catacombs of California. I have built several pieces of furniture and have read most of the literature on the subject, but this work, by a young woman of extraordinary graphic expertise, comes closer to teaching me about the hand-eye-God connections than anything else has to this point in my education. June Sprigg worked with what Shakers are left, (celibacy is one means of zero population growth), and has created a great book, full of detailed drawings, good prose, and a love of labor. Did you know that the circular saw was invented by a spinner, Sister Tabitha Babbit?

–j.d. smith

By Shaker Hands
June Sprigg
1975; 208pp.
$15.00 postpaid

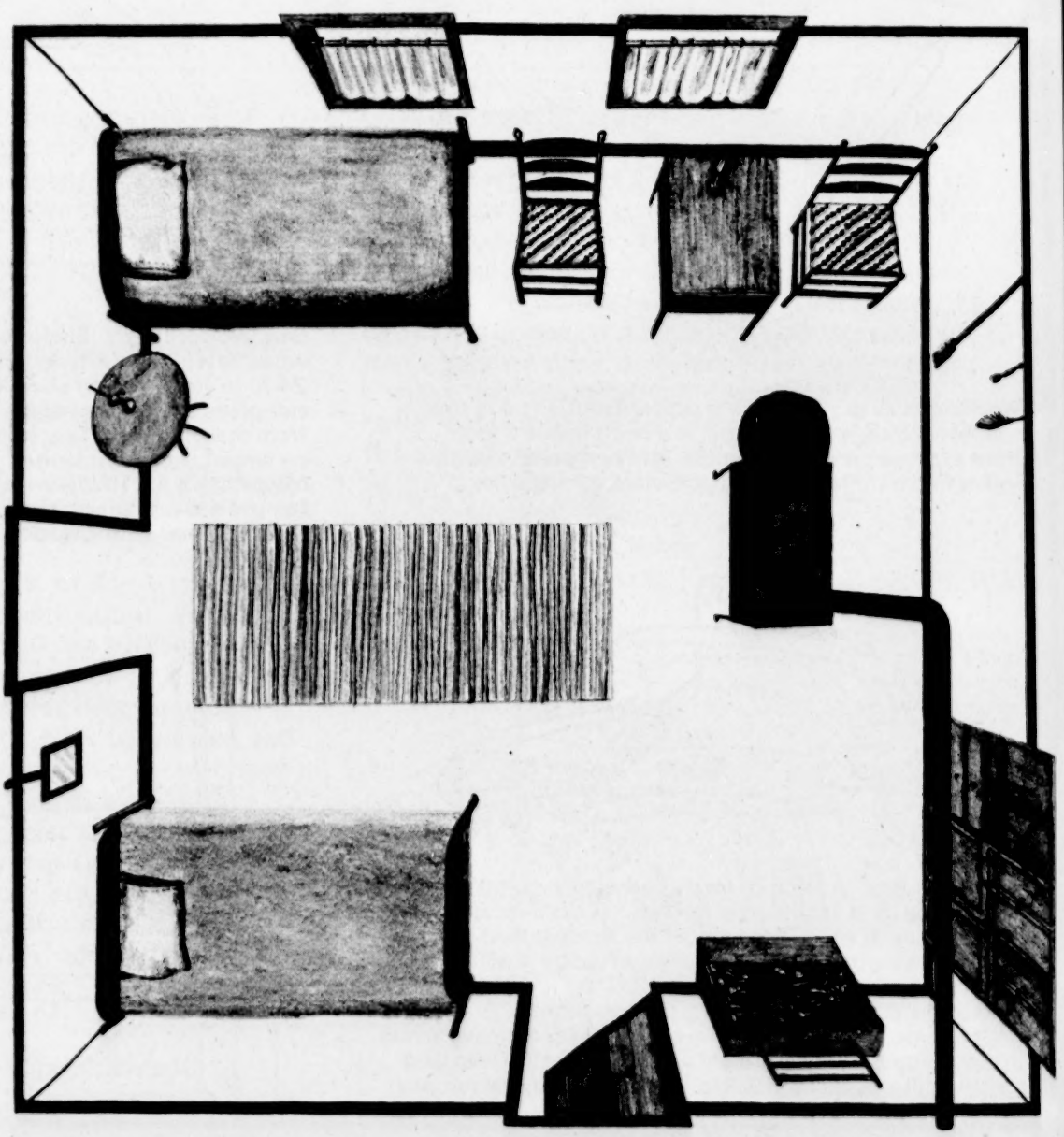
from:
Alfred A. Knopf, Inc.
455 Hahn Rd.
Westminster,
MD 21157
or Whole Earth

Shaker furniture often had drawers on two or three sides, like this pine sewing chest (c. 1830) from Enfield, Connecticut. Shakers had the space to use these chests, which had to stand where drawers on all sides were easily reachable. The space they saved made work and movement more convenient.



Double calipers saved time for the carpenter because he could record two different measurements at once.

My Mother is a carpenter
She hews the crooked stick
And she will have it strait and squair
Altho it cuts the quick.



Space was at a premium in Shaker Dwellinghouses, since a Shaker Family often numbered over a hundred. They made the most of limited space by furnishing very simply. Ideally, a Shaker dwellingroom for Brother or Sister was to contain little more than (clockwise from upper left):

one candlestand
two beds on rollers, easily movable
several large windows for light and ventilation
two straight chairs
one lamp
one table
one broom and several clothesbrushes
one small iron wood-burning stove for heating
one or more built-in cupboards and sets of drawers
one woodbox with dustbrush
one small hanging mirror
one simple carpet
. . . and of course wall pegs.

Health Hazards Manual for Artists

In a previous incarnation, I taught art at a state college. I was alarmed at the number of students that ran into trouble with various sutstances but I didn't know where to look for information. (I got epoxy poisoning myself). This pamphlet spells it out clear and simple. It is appalling. You don't necessarily have to be an artist to get poisoned by the materials mentioned, of course. Wintergreen flavored library paste is not listed. I suppose if it were toxic, we'd have lost an entire generation.

—J. Baldwin

Health Hazards Manual for Artists
Michael McCann, Ph.D.
1975; 28pp.
$2.25 postpaid

from:
Alex Gross
1292 Lamouree Rd.
Saugerties, NY 12477

Inhalation of the dust from the sanding of wood can cause severe lung problems. Many woods are treated with chemicals like fire-retardants and fungicides. These chemicals can be inhaled along with the wood dust. Many carpenters get nasal sinus cancer. However, it is not known whether it is due to the wood dust or to the chemical additives.

Redwood dust can cause an acute illness resembling pneumonia. It appears a few hours after exposure with symptoms of shortness of breath, dry coughing, chills, sweating, fever and weight loss. A person with this usually recovers from a first attack without any ill effects, but repeated exposures can result in lung scarring and decreased lung capacity.

Colorado Fleece Company

Nice to know these good people sell direct. I've been spinning small quantities of their dark columbian fleece for years. Have you as well?

—Diana Sloat

The grease wools are:
Grey & Black Columbian, (Med. Staple) 10 lb. Minimum
Karakui (seasonally)
Montedale (long staple, very clean)

Processed fibers are:
Mongolian camel hair, coarse 20 lb. Minimum
Mongolian camel hair, fleece
Goat hair 20 lb. Minimum
White or Grey silvertop 5 lb. Minimum
Silvertop mohair
Scoured mohair

Write for samples & current price list.

From:
Colorado Fleece Company
516 West Ute Ave.
Grand Junction, CO 81501

Art Needlework Industries

A delight to the eye & fingers! Sumptuous wool yarns: magnificent Harris tweed handspun, Shetland heathers, heavy Scottish "Homespun double-knit," heather mohairs. Widest range of shades, textures & weights & plys I've seen in a while.

Along with samples comes a flood of pattern & kit catalogues. Great for ideas, even if you're not usually into them. The Florentine flame stitch designs (Bargello) are rich and innovative; needlepoint "tapestry" kits range into landscapes, "oriental" rugs.

No mention of charge for samples, tho hard to imagine they're free.

—Diana Sloat

from:
Art Needlework Industries, Ltd.
7 St. Michael's Mansions
Ship Street
Oxford OX1 3DG
England

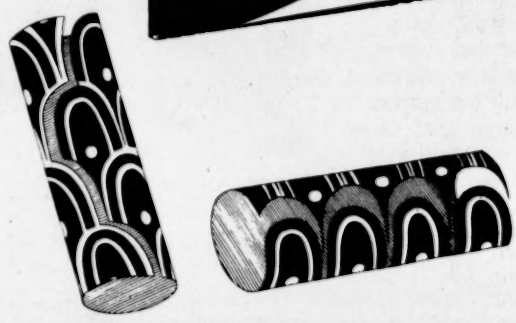
Fabric Printing: Screen Method

Dynamite! Years of experience packed into this informative book. It strides through a vast amount of material easily and in the simplest language. Make your own screens and printing table, cut your own stencils, set up a darkroom and do your own photo stencils. It's all there: complete instructions with properties of fabrics, dyes, pigments, and other chemicals thoroughly and efficiently presented along the way. Extensive supplier's list included. Hurrah for authors, artist & publisher — for $3.95 it's a people's book and pretty, too!

—Diana Sloat

Fabric Printing: Screen Method
Richard Valentino & Phyllis Mufson
1975; 49pp.
$3.95 postpaid

from:
Bay Books
3665 Clay Street
San Francisco, CA 94118
or Whole Earth



Put your design into a non-rectangular format. You are doing this because a design with a straight edge looks static to the eye when printed and also creates problems in printing, because it makes any flaw in registration more obvious. An irregular edge deceives the eye and creates the illusion of flow. Make sure the unit links from top to bottom and from side to side. One way to check that the linking is correct is to roll your drawing into a cylinder from top to bottom and from side to side.

Star Wool Stores

Specialize in Aran wools for knitting. Choose your own pattern & order the yarn. Or you can have one knitted:

> **Customers choose type of pattern & Aran wool, give the three sizes required, i.e., chest, measured all around under the arms; sleeve, measured under the arm; and, body length, measured under the arm. Knitting time is about one month.**

They offer several grades of wools and wool/synthetic blends, both scoured and oiled (water repellant) in natural shades and colors, too.

(The real stuff is worth it. My cardigan, now much mended, has survived 10 years of hard wear. It repelled water for a good 2 years till it stood alone, grey-tan and raunchy, repelling friends in our pristine culture. The oil's now gone but its character isn't. If you or someone else invests that amount of time, love & labor, the materials should be good.)

—Diana Sloat

Star Wool Stores
Attn: Mr. & Mrs. J. S. Cole
128 High Street
Bangor, North Ireland

Shelter

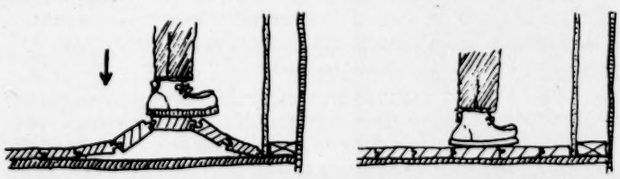
Illustrated Housebuilding

Housebuilding books usually are either so simplified that the necessary small details aren't there, or there are so many details that you drown in them. This book is just right. A novice could actually build a good house from it. The illustrations deserve special mention for clarity. This is the book I'd use myself if I had to do a house.

—J. Baldwin

Illustrated Housebuilding
Graham Blackburn
1974; 156pp.
$10.00 postpaid
from:
The Overlook Press
c/o The Viking Press
625 Madison Ave.
New York, NY 10022
or Whole Earth

As well as customs and ceremonies associated with housebuilding, there are also many time-honored tricks played by tradesmen to ensure payment. One such trick was the mason's habit of building a pane of glass across the chimney, high up in the flue. The glass being clear, no obstruction could be seen, but the fire would not draw until the mason was paid — when he would then simply drop a brick down the chimney!

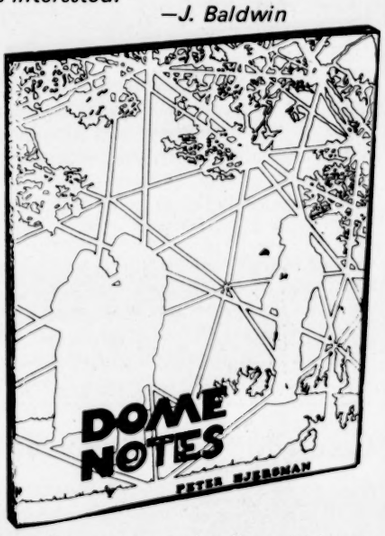


The secret of getting the last few boards down tightly lies in not nailing them! Fit them together, buckled, and then press them into place by standing on them.

Dome Notes

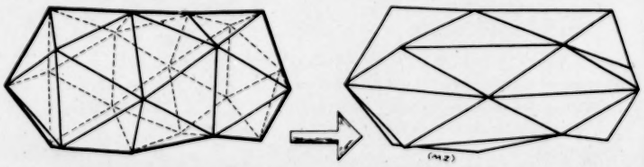
Many leaky domes have pretty well removed such construction from faddishness. Yet there are still very good reasons for making a dome. Extraordinarily good thermal performance is probably the most important. Regrettably, most available dome books concentrate on esthetics, grooviness or economics (usually unrealistically), leaving waterproofing and other real-world details to the builder's guess. Now there are some real workbooks beginning to appear. This is one. It concentrates mostly on clearly explaining the geometry, tensegrity structures, the design and testing of hubs, and fire safety. The fire section is most detailed; the author actually deliberately burned down an instrumented dome to get the facts! If domes are part of your life, you might be interested.

—J. Baldwin



Dome Notes
Peter Hjersman
1975; 201pp.
$6.00 postpaid
from:
Erewhon Press
Box 4253
Berkeley, CA 94704
or Whole Earth

Often people attempt to illustrate the fire safety of urethane by applying a welding torch flame to foam. This is as inaccurate a test as the other small scale tests. One of the main factors that contributes to a major fire within an enclosed compartment is the buildup of flammable gases. Holding a torch to a piece of foam cannot simulate this.

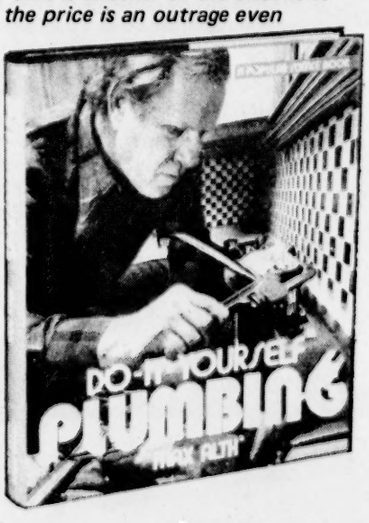


Aggregates: *Icosahedra can be aggregated and diamond solids can be generated from some of them.*

Do-It-Yourself Plumbing

There are many books that adequately handle this subject (another good one EPILOG p. 518) but this one is special: In addition to being commendably clear on repairs, both graphically and in the text, it has a really fine section on designing your own plumbing system. I especially like the author's insistence on explaining the basic reasons underlying his instructions and also building codes. That way you really learn something. This is another of the excellent Popular Science books, but the price is an outrage even these days.

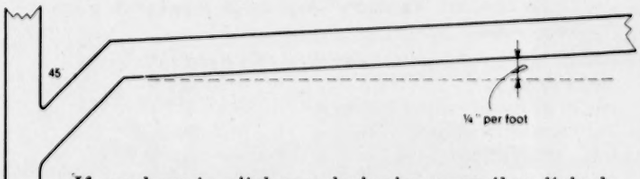
—J. Baldwin



Do-It-Yourself Plumbing
Max Alth
1975; 301pp.
$11.95 postpaid
from:
Harper and Row
Keystone Industrial Park
Scranton, PA 18512
or Whole Earth

Pitch. All drainage pipe lines are pitched downward towards the sewer pipe. All properly installed drainpipe has a pitch of no less than 1/8 of an inch and no more than 1/2 inch to the foot. When this pitch is impossible or impractical, the pipe is pitched at 45 degrees (1 foot drop for every foot of pipe length) or more.

It has been found by means of a series of noxious tests that soil flows best in a pipe pitched at 1/4 inch to the foot. A pitch greater than 1/2 inch to the foot causes the liquids to run off and leave the solids behind. In time the drain will plug up. Pipes pitched at less than 1/8 inch to the foot do not provide sufficient water velocity and the solids tend to settle and clog and there is insufficient scouring action.



If you have to pitch any drainpipe more than ½ inch to the foot to reach a stack, run a section of the pipe at 45 or more degrees and the balance at ½ or ¼ inch to the foot.

Community

Lehman Hardware Catalog

Kerosene refrigerators, kerosene irons, wooden butter churns, gas engine clothes washers, butcher saws, hog scrapers, and more kinds of wood heatstoves and cookstoves than I knew existed. A good catalog.

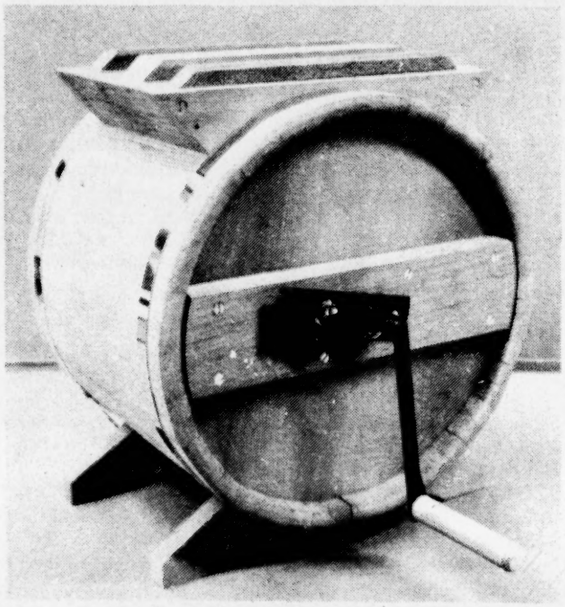
—SB
[Suggested by John Ellis, Jr.]

Catalog

$1.00 postpaid
from:
Lehman Hardware & Appliances, Inc.
Box 41
Kidron, OH 44636

Heavy gray iron one-piece gear case; finished in tu-tone porcelain hammertone enamel.
Machine cut helical gear and pinion; extra long bearings. Unbreakable steel handle; adjustable steel tool rest. Oversize handle grip. Equipped with high grade grinding wheel.

Grinding wheel 5 x 1 x 3/8 in.; wt each 6 lbs. $14.68

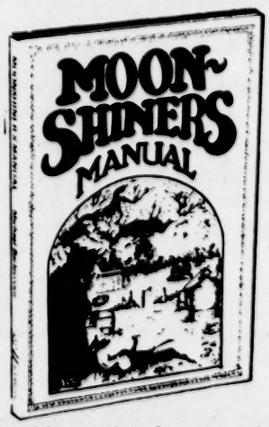


Wooden Butter Churn
3 gal. capacity — made from Redwood. Removable paddles.
13 inches in diameter
11 lbs. $45.95

Moonshiners Manual

Alcohol, like marijuana, is a controlled substance. That means that the government is involved at the tax level apart from the moral level. This little manual does for the booze freak what the **Cultivator's Handbook of Marijuana** *did for the home botanist. It gives you full, careful, somewhat glib information on how to produce your own stumphole moonshine at home, or back in the woods, including a nice little chapter on kitchen stills.*

—J.D. Smith



Moonshiners Manual

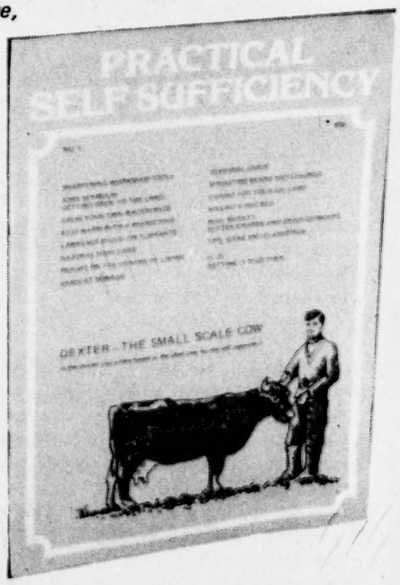
Michael Barleycorn
1975; 150pp.
$3.95 postpaid
from:
Oliver Press
1400 Ryan Creek Road
Willits, CA 95490
or Whole Earth

There are two basic steps involved in getting from cracked corn to mountain dew. First, the corn has to be **fermented**. What happens here is that you add sugar to the corn, add water, and then yeast. This mess is called **mash**. The yeast will multiply in the warm water and will exist on the sugar, which it eats. As the yeast consumes the sugar, it excretes carbon dioxide and ethanol or alcohol (more commonly known as loose juice.) The alcohol stays with the mash, and the carbon dioxide bubbles off into the air. The yeast will multiply and consume, and produce the magic juice with enthusiasm. But as all good things must come to an end, and this is no exception, the yeast produces so much alcohol that it starts killing itself faster than it can multiply and the process grinds to a halt as the sugar is used up and the yeast dies off. The liquid you have left is a crude beer containing approximately 16% alcohol: the mash.

Practical Self Sufficiency

This could be the English answer to the hemi-powered, full-blown, make-it-as-a-candlemaker-alone-in-the-wilderness, impractical isolationism which has plagued American simplethink for the past few years. Edited by a woman, precise (British) in language, and careful in its advice, **Practical Self Sufficiency** *promises to be a fruitful mating of Mama Earth with Ye Old Sod.*

—J.D. Smith



Practical Self Sufficiency

Katie Thear, ed.
6 issues/yr
£5 /yr postpaid
($10.25 currently)
from:
Broad Leys Publishing Co.
Widdington,
Nr. Saffron Walden
Essex CB11 3SP
England

Oil Lamp Wicks: No wick should be in use longer than three months. New wicks should be thoroughly dried in the oven, and when trimmed care should be taken to round off the corners properly, or an uneven flame will result, and probably cause the glass to crack. When new wicks are necessary the entire container should be emptied of oil, and, together with other portions of the part holding the wicks, should be either boiled in a special saucepan kept for the purpose, or thoroughly scalded in strong soda water, care being taken that the whole is thoroughly dried before the new wick is put in, and the fresh oil into the container.

A Barefoot Doctor's Manual

A Barefoot Doctor's Manual *is the best general health manual I've read so far and I've read many because I'm preparing one myself. The book is sensibly divided into sections like Understanding the Human Body, Hygiene, Therapeutic Techniques, Birth Control and Diagnosis and Treatment of Common Diseases. It's holistic in approach, stressing the relationship of environment and emotions to disease while offering a variety of treatment modalities. The practitioner is given a choice of treating each disease with acupuncture, Chinese herbs, or Western medicine. For those unfamiliar with Chinese herbs,* **A Barefoot Doctor's Manual** *contains over 400 pages on their preparation and uses with illustrations. If I were a nurse on a commune this would be my main source book. Best of all, maybe, the book was translated by and available from the U.S. Department of Health, Education and Welfare.*

—Eugene Schoenfeld, MD
[Suggested by Peter Ratner]

A Barefoot Doctor's Manual
1974; 960pp.
$9.75 postpaid
from:
Superintendent of Documents
U.S. Govt. Printing Office
Washington, DC 20402

Chair method of transport

To eliminate maggots

(1) Cover layers of compost piled over the maggots with dirt in sufficient amounts to seal them in and kill them.
(2) Pour cow manure into the latrine.
(3) Retrieve the maggots and feed them to ducks. Pouring boiling water and emptying hot ashes over the maggots is also an effective method.
(4) Use traditional Chinese medicinal herbs.
(a) Crush whole plants of stargrass (*Aletris spicata*) or *Clerodendron bungei* (ch'ou mu-tan) and throw into excreta crock.
(b) Mix and crush plants of groundsel chui-li-kuang (*Senecio scandens*), Japanese pepper, and plume poppy (*Macleaya cordata*), and pour into waste water or latrine.
(c) Use a 5% extract of tea-seed bricks (compressed residue of tea seeds after oil has been extracted) or add 2 - 4 liang of the tea-seed brick into the latrine or cesspool and stir for maximum effectiveness in killing maggots and larvae. . . .

Crush tobacco leaves and add to rice gruel or congee which will bait and kill flies.

•

To recognize and understand disease we must be in close contact with the patients and study them with care.

•

Massage by t'ui-na (pushing and grasping) and an-mo (palpate and massage) techniques is simple and effective. It is used to treat a wide range of illnesses. Massage can clear the meridian vessels, stimulate circulation of energy and blood, loosen up stiff joints, and increase body resistance to disease. . . .

New Woman's Survival Sourcebook

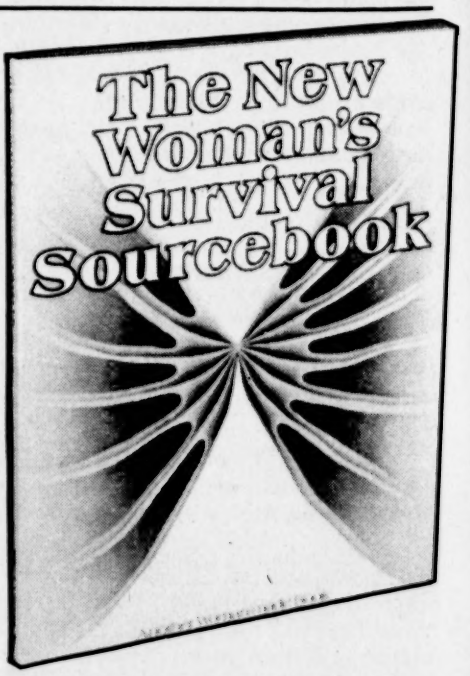
The **Sourcebook** *expands on the method used in the* **New Woman's Survival Catalog** *(EPILOG, p. 582) to list women's resources. The proliferation of activity in the feminist movement has enforced concise and selective presentation of 3-years-worth of new material as well as more attention to ideology (excellent essays precede resource information — self-help health care, the ERA, violence against women, feminist fiction, child care, an interview with Adrienne Rich and Robin Morgan on poetry, among others). The means of survival are more diverse and refined, which is a measure of the success of the first volume.*

—Diana Fairbanks

The "Survival Sisters," Kirsten Grimstad and Susan Rennie, are carrying their cataloging enthusiasm a step beyond, into a bi-monthly magazine called **Chrysalis**. *Each issue will have a center rip-out section ala* **Sourcebook** *listings; the first issue (out November 1976) will feature a catalog of international feminist resources. Charter subscription costs $8 from:* **Chrysalis**, *c/o Women's Building, 1727 N. Spring St., Los Angeles, CA 90012.*

—Pam Cokeley

The New Woman's Survival Sourcebook
Kirsten Grimstad, Susan Rennie, eds.
1975; 245pp.
$5.00 postpaid
from:
Alfred A. Knopf
455 Hahn Rd.
Westminster
MD 21157
or Whole Earth



It is now common knowledge that rape increased dramatically in the nineteen-sixties. (Incidentally, it was on the increase well before feminism activated an increase in reporting rape.) During the same period there was a *threefold greater increase in wife battering* in the United States. **The New York Times** (October 21, 1974) reported that approximately 14,000 wife-battering cases were processed through New York state courts in 1973. (The number of reported rapes in New York state for the same period were 4,764.) The kinds of violence at issue here are the savage beatings that send women to hospitals: with concussions, broken jaws, broken ribs, punctured lungs, severe lacerations and scaldings, broken arms. And these beatings occur in homes of all social classes.

Follow-up on the "no jelly" diaphragm

In the Fall '75 CQ, I wrote a short article about the "hinge," or "arching," Koroflex diaphragm, reporting that one doctor's patients have been using it successfully without jelly for several years.

Over a hundred people responded to that article and wrote the Holland-Rantos Company, who make both the Koroflex diaphragm and spermicidal jelly. This prompted the Rantos people to look me up, and when they came to San Francisco for their annual convention, the executives invited me out one night.

I felt honored until these men started to mau-mau me over drinks. They said I should write a retraction; it was clear the company didn't want anyone getting the idea that spermicidal jelly or cream might not be necessary. Their conversation stunk of profit motive, but I also felt they believed what they were saying. Why shouldn't they? The entire medical profession has been so convinced of the necessity of spermicides that there has been essentially no research on the viability of a well-fitted hinge diaphragm used alone.

In fact, mercury remained the active ingredient in all spermicides long after it had been removed from most other drugs. Only in the past year has mercury been replaced by another chemical of similar molecular structure. Kay Weiss, of Advocates for Information in Houston, told me, "I think the cream and jelly are very harmful even without mercury. Any chemical in a spermicide is going to be absorbed through the vaginal tissue and into the blood stream. A woman must aks herself, 'Would I want to drink this?' because the effect is the same."

The first diaphragms were citrus rinds, like half an orange rind, used centuries ago. As the director of one birth control clinic explained, "With the development of spermicide, the concept of the diaphragm has changed from being a crucial sperm barrier to being simply a device which holds the spermicide up against the cervix."

Research in human sexual response has shown that during female orgasm, the uterus and cervix contract and move, leaving an open space between the diaphragm rim and the cervix for a few seconds. If the man ejaculates at that time, or if he has ejaculated before her and there is sperm in the vagina, it can get under the diaphragm during her contractions.

These findings are with a regular diaphragm. Not even Masters and Johnson have done any research on the Koroflex model. Many doctors agree that the Koroflex is different because it fits tighter than other 'phragms. But birth control clinics report an astonishing number of patients whose hinge diaphragms have been ill fitted by their doctors. The Holland-Rantos Co. verified this – many doctors are giving women the wrong size diaphragm or not bothering to fit them at all. The best bet is to go to a doctor who understands and believes in the Koroflex, not a doctor who thinks you really should go on the pill.

The hinge diaphragm was developed in Holland and was in fairly wide use there by World War II. During the war, since petroleum was unavailable, so was spermicidal cream and jelly. A woman gynecologist who was practicing in Holland at that time said she saw no increased rate of pregnancy from women using the diaphragm without jelly. But she knew of no statistics.

The drug company has no statistics either. A spokesman for Holland-Rantos said, "To my knowledge, nothing has been done comparing the Koroflex diaphragm with spermicide to using the diaphragm alone."

Ms. Weiss of Advocates for Medical Information said, "It's a shame women have to do their own research on this." But it was surprising to the Holland-Rantos executives that some women are actually willing to take the risk of pregnancy by foregoing the jelly. Whether or not it is a health hazard, jelly is unpleasant enough, taste-wise, time-wise and psychologically, that the idea of not using it is appealing. The jellyless diaphragm users I've talked with are mainly former pill or IUD users who are accustomed to convenience and prefer a possible pregnancy to a chance of cancer.

Since there are women taking the chance, the doors are open for control group research. It would require a large group of women for several years, involving several hundred thousand intercourses. Half of the subjects would use the hinge diaphragm with spermicide; half, the 'phragm alone. The rate of intercourse and rate of pregnancy could be compared.

Any CQ readers who are trying the jellyless diaphragm, or have any further information, please let us know, whichever way it goes.

The main thing I learned from all this is that the answers in birth control are still mainly hunches. Physicians feel pressured to come up with answers. We're all so eager for the fantasy birth control method – one that's safe, easy and pleasant – that it's tempting to oversimplify the options. For those who use it jellyless, the hinge diaphragm is a dream come true – as long as they don't get pregnant. But, in these days when a good lambskin condom costs $1.25 a shot, what's a mother to do?

–Rosemary Menninger

What Do We Use for Lifeboats When the Ship Goes Down?

The usual high quality interviews and photographs by my (as in his **Observations from the Treadmill**, *EPILOG, p. 680). This time with Robert Reines, John Todd, Ian McHarg, Paolo Soleri, Richard Saul Wurman, and the introduction we printed in the Summer '75* **CQ**.

–SB

What Do We Use for Lifeboats When the Ship Goes Down?
my
1976; 201pp.
$3.95 postpaid
from:
Harper Colophon Books
Harper & Row
Keystone Industrial Park
Scranton, PA 10022
or Whole Earth

Talc-asbestos hazard

Watch out for talcum powder; that is, watch out for asbestos. Talc is a crystal of similar structure to asbestos. They are found together geologically, and it's hard to mine one without extracting the other right with it. Asbestos fibers are therefore present in talc; they are easily inhaled and lodge in the lung tissue, causing a build-up of surrounding cells which can become cancerous.

I recently told a friend about this and she was amazed. "The image I have of my aunt," she said, "is of her standing in clouds of talcum powder after a bath. She was a nurse and a fastidious woman. She puffed more powder on herself than you can imagine; and even though she never smoked, she died of cancer at an early age." No diagnosis but a definite coincidence.

The Trojan condom people say they now remove the asbestos before dusting their rubbers. I don't know how this is done or how completely the fibers are removed, but it indicates an alert corporation. This is not a "might cause cancer in rats" scare; asbestos causes cancer in people. Ask the folks who mine it.

–Rosemary Menninger

From Huey Newton in Cuba

October 24, 1975

Nowhere is here

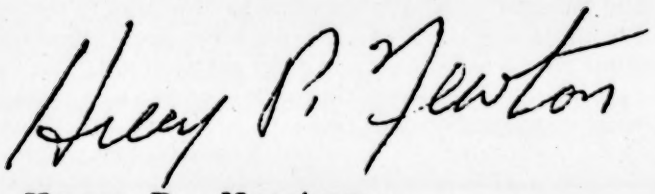
here is nowhere

Now is here

here is now

Now here is Nowhere

Is - is everywhere!



Huey P. Newton

The Book of Tofu

Soybeans have been the staple protein of the Far East for millennia, but rather than taking them straight (I guess Orientals must not like plain soybeans any more than most Americans seem to), they have developed several kinds of foods made from soybeans which have become basic to oriental cuisine: miso (fermented soybean paste), shoyu (soy sauce), and tofu. Tofu is a soft, delicate product made from curdling soymilk, in much the same way that cows' milk is curdled to make cheese. It contains some 73% of the protein of whole soybeans. Nearly neutral in flavor and consistency (considered a delicacy by itself in the Orient), it can be made to imitate practically any other protein food, or used to create an almost limitless range of tastes and textures. This book about tofu is a monumental work resulting from three years of study and travel in Japan by the authors (including a one-year apprenticeship to a tofu master), exhaustively covering all aspects of the history, preparation, use and nutritional value of tofu. There are over 500 recipes using tofu and related products in both Eastern and Western style cooking; simple instructions for making several varieties of tofu and related products at home and on a community scale; an illustrated description of the art of making tofu in a traditional Japanese shop; directories of Japanese tofu restaurants, tofu shops in the West, sources of supplies for making tofu, and people and institutions connected with tofu; a detailed glossary of Japanese foods and cuisine; and much more. Over 300 clear and detailed illustrations by Ms. Aoyagi supplement and clarify the text.

And There Was Light

"See the blind man."

Is what all of them were told, the new volunteers for the Resistance in France in 1940. They were mostly men and women in their late teens or early twenties. So was the blind man.

He went blind at eight and soon learned to see much more richly without vision. He kept up a double life as a brilliant student and major leader in the Resistance — it was he who tested the trustworthiness of new recruits. When his entire section was captured by the Nazis, only he survived the death camps. It's a story of friendship so deep and religion so manifest that it can make you regret the shallow convenience of sight.

—SB
[Suggested by Renée des Tombe]

And There Was Light
Jacques Lusseyran
1963; 244pp.
Little, Brown & Co.

(The book is out of print. Look for it in libraries and used book stores, or help get it back in print.)

A sound we don't listen to is a blow to body and spirit, because sound is not something happening outside us, but a real presence passing through us and lingering unless we have heard it fully.

I was well protected from these miseries by parents who were musicians, and who talked around our family table instead of turning on the radio. But all the more reason for me to say how important it is to defend blind children against shouting, background music and all such hideous assaults. For a blind person, a violent and futile noise has the same effect as the beam of a searchlight too close to the eyes of someone who can see. It hurts. But when the world sounds clear and on pitch, it is more harmonious than poets have ever known it, or than they will ever be able to say.

•

As I walked along a country road bordered by trees, I could point to each one of the trees by the road, even if they were not spaced at regular intervals. I knew whether the trees were straight and tall, carrying their branches as a body carries its head, or gathered into thickets and partly covering the ground around them.

This kind of exercise soon tired me out, I must admit, but it succeeded. And the fatigue did not come from the trees, from their number or shape, but from myself. To see them like this I had to hold myself in a state so far removed from old habits that I could not keep it up for very long. I had to let the trees come towards me, and not allow the slightest inclination to move towards them, the smallest wish to know them, to come between them and me. I could not afford to be curious or impatient or proud of my accomplishment. . . . The indispensable condition for accurately pointing out trees along the road was to accept the trees and not try to put myself in their place.

All of us, whether we are blind or not, are terribly greedy. We want things only for ourselves. Even without realizing it, we want the universe to be like us and give us all the room in it. But a blind child learns very quickly that this cannot be. He has to learn it, for every time he forgets that he is not alone in the world he strikes against an object, hurts himself and is called to order. But each time he remembers he is rewarded, for everything comes his way.

•

The evidence stared us in the face. The men over thirty round about us were afraid: for their wives and their children — these were real reasons; but also for their possessions, their position, and that is what made us angry; above all for their lives, which they clung to much more than we did to ours. We were less frightened than they were. The years ahead would prove the point. Four-fifths of the Resistance in France was the work of men less than thirty years old.

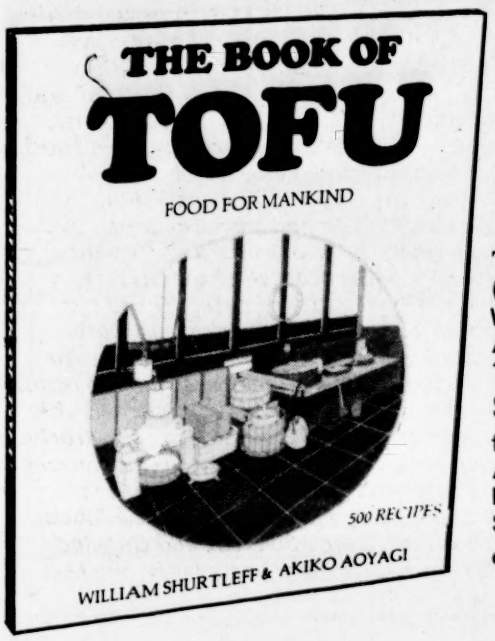
•

Remarkable that that year I almost never said, 'I myself think, I want, I believe.' There was always someone else there to believe with me, to think in my place. Usually it was Jean, but sometimes it was Francois, Denis, Simone, Philippe, Catherine, Frederic. And for them it was the same thing. There was not one of them who didn't recognize it, not only with pleasure, but with the sense that his whole being was in process of growth. This fraternity was the greatest virtue of the Resistance. But fraternity is a poor way of expressing it. It was really a sharing of the heart.

There were about twenty of us, living intertwined with our hearts open to one another, one protecting the next man, the next man protecting him, in a traffic of common hopes so close and so continuous that in the end it made an opening in our skins and fused us all into a single person.

The authors recently came to the San Francisco Zen Center (where Shurtleff was formerly a student) to demonstrate the manufacture and use of tofu. I was amazed at the speed and simplicity of the process, and delighted with the delicious flavors of the fresh products. The tofu mayonnaise dips were especially good. The authors are also planning a second volume (a technical manual for the commercial preparation of tofu) and a similarly detailed work on miso.

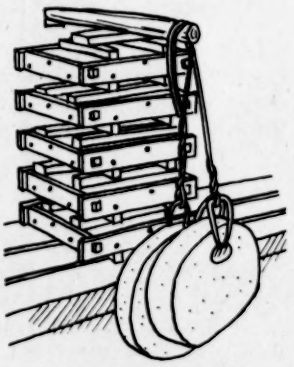
—Andrew Main



The Book of Tofu
(Food for Mankind)
William Shurtleff and
Akiko Aoyagi
1975; 336pp.
$6.95 postpaid
from:
Autumn Press, Inc.
P.O. Box 469
Soquel, CA 95073
or Whole Earth

To make fine homemade tofu, you will need the following common kitchen tools:

An electric blender, food- or grain mill, or meat grinder
A "cooking pot" with a capacity of 1½ to 2 gallons
A "pressing pot" with a capacity of 1½ to 2 gallons, or a basin of comparable size
A 2-quart saucepan
A wooden spatula, rice paddle, or wooden spoon with a long handle
A shallow ladle or dipper about 1 inch deep and 3 or 4 inches in diameter, or a large spoon
A rubber spatula
A sturdy 1-quart jar or a potato masher
A 1-cup measuring cup
A set of measuring spoons
A large, round-bottomed colander (that will fit into the "pressing pot")
A flat-bottomed colander ("settling container") preferably square or rectangular
A shallow fine-mesh strainer or bamboo colander (*zaru*)
A coarsely-woven cotton dishcloth, 2 feet square, or a "pressing sack"
A 2-foot square of cheesecloth, or a light cotton dishtowl of comparable dimensions



Pressing curds

The Country of the Pointed Firs

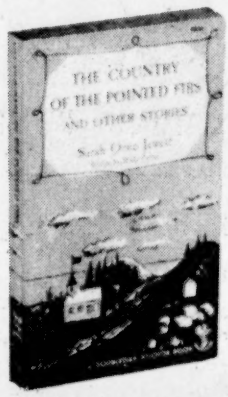
One of the reasons that I keep reading the humanist journal Manas *(CATALOG, p. 410) is that nearly every week it has some good old book to recommend. As a rule good old books are better than good new ones. Also there's more of them. Why are they so seldom reviewed?*

Anyway here's one. Written by a New England woman mostly about New England women, it contains in its stories more of the craft of lucid writing and of honorable living than any other fiction I've seen. Willa Cather remarks in the preface, "If I were to name the three American books which have the possibility of a long, long life, I would say at once The Scarlet Letter, Huckleberry Finn, *and* The Country of the Pointed Firs. *I can think of no others that confront time and change so serenely."*

The stories are set in Maine seacoast towns early in this century. You can smell them and hear the voices. The lives make large distinct patterns, turning on single events and lifelong strengths. These are old virtues. Their joys are slow and deep and far from simple. Here in California I miss them like thunderstorms.

—SB
[Suggested by Sally Nicholson]

The Country of the Pointed Firs
Sarah Orne Jewett
1896; 320pp.
$2.50 postpaid
from:
Anchor-Doubleday & Co., Inc.
501 Franklin Ave.
Garden City, L.I., NY 11530
or Whole Earth



"Last time I was up this way that tree was kind of drooping and discouraged. Grown trees act that way sometimes, same's folks; then they'll put right to it and strike their roots off into new ground and start all over again with real good courage. Ash-trees is very likely to have poor spells; they ain't got the resolution of other trees."

I listened hopefully for more; it was this peculiar wisdom that made one value Mrs. Todd's pleasant company.

"There's sometimes a good hearty tree growin' right out of the bare rock, out o' some crack that just holds the roots;" she went on to say, "right on the pitch o' one o' them bare stony hills where you can't seem to see a wheel-barrowful o' good earth in a palce, but that tree'll keep a green top in the driest summer. You lay your ear down to the ground an' you'll hear a little stream runnin'. Every such tree has got its own livin' spring; there's folks made to match 'em."

•

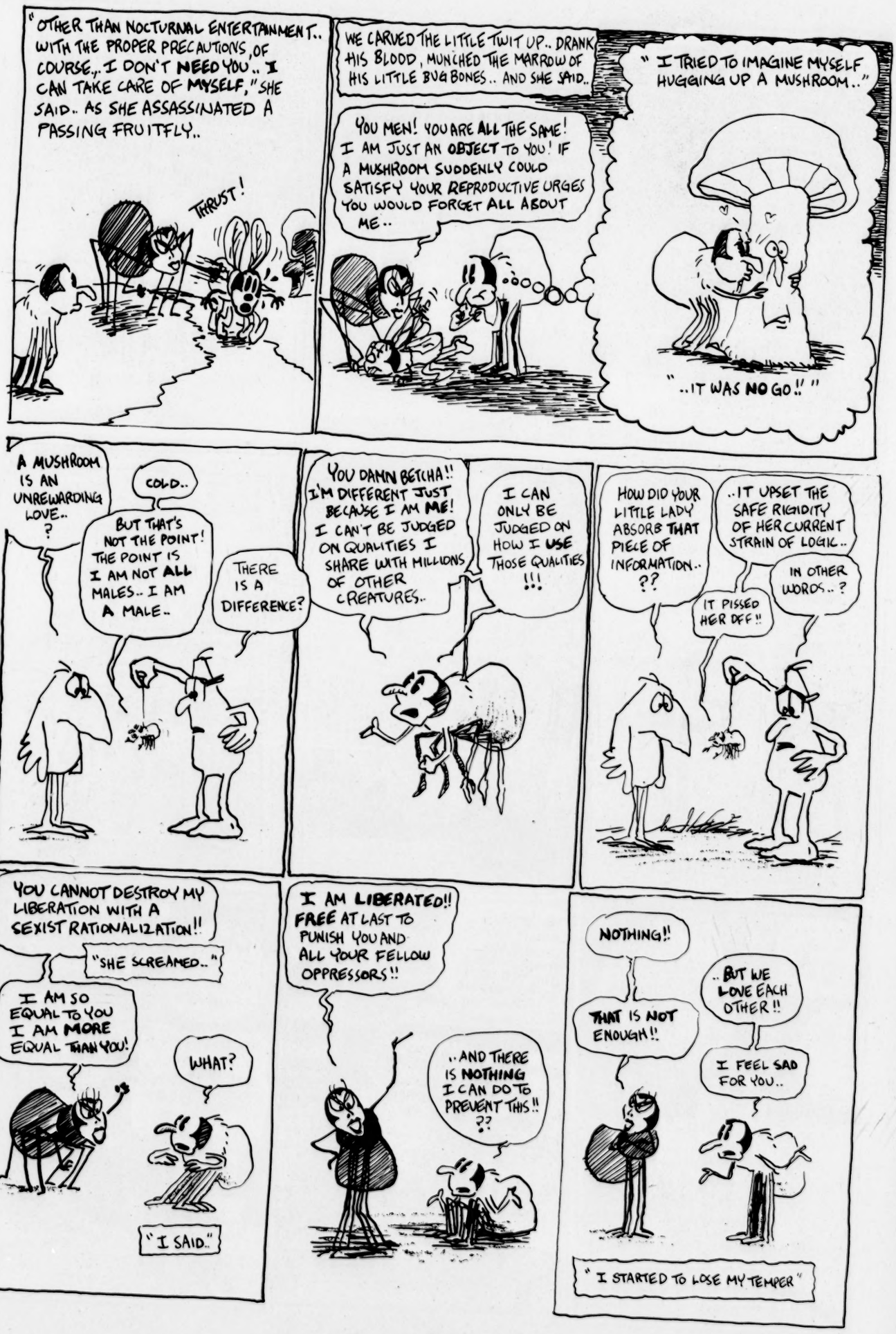
"I wish I had known her; Mrs. Todd told me about your wife one day," I said.

"You'd have liked to come and see her; all the folks did," said poor Elijah. "She'd been so pleased to hear everything and see somebody new that took such an int'rest. She had a kind o' gift to make it pleasant for folks. I guess likely Almiry Todd told you she was a pretty woman, especially in her young days; late years, too, she kep' her looks and come to be so pleasant lookin'. There, 't ain't so much matter, I shall be done afore a great while. No; I sha'n't trouble the fish a great sight more."

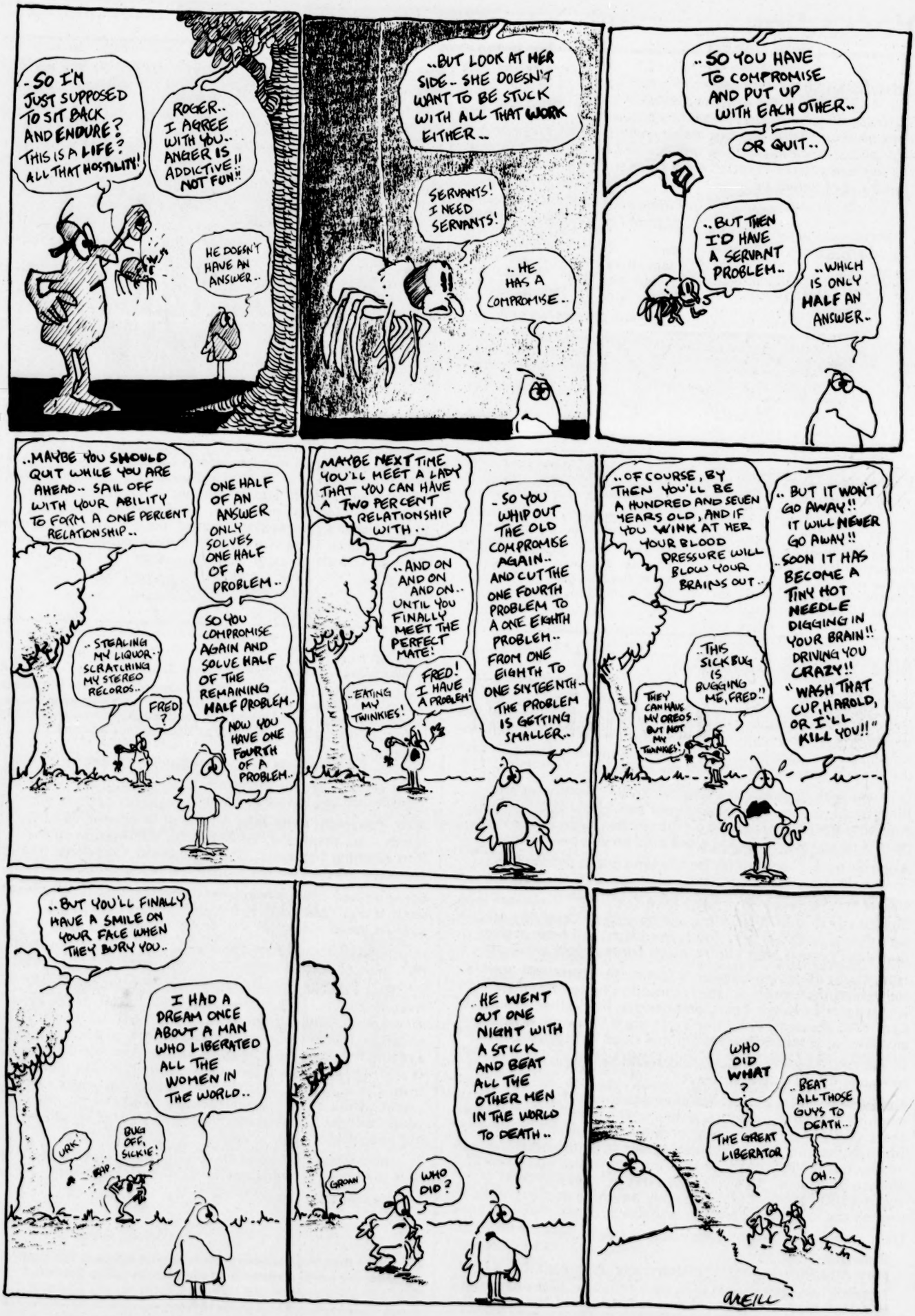
The old widower sat with his head bowed over his knitting, as if he were hastily shortening the very thread of time. The minutes went slowly by. He stopped his work and clasped his hands firmly together. I saw he had forgotten his guest, and I kept the afternoon watch with him. At last he looked up as if but a moment had passed of his continual loneliness.

"Yes, ma'am, I'm one that has seen trouble," he said, and began to knit again.

In each CQ, cartoonist Dan O'Neill has total control of four pages. Exempli gratia:


"OTHER THAN NOCTURNAL ENTERTAINMENT.. WITH THE PROPER PRECAUTIONS, OF COURSE,.. I DON'T NEED YOU.. I CAN TAKE CARE OF MYSELF," SHE SAID.. AS SHE ASSASSINATED A PASSING FRUITFLY..
THRUST!
WE CARVED THE LITTLE TWIT UP.. DRANK HIS BLOOD, MUNCHED THE MARROW OF HIS LITTLE BUG BONES.. AND SHE SAID..
YOU MEN! YOU ARE ALL THE SAME! I AM JUST AN OBJECT TO YOU! IF A MUSHROOM SUDDENLY COULD SATISFY YOUR REPRODUCTIVE URGES YOU WOULD FORGET ALL ABOUT ME..
" I TRIED TO IMAGINE MYSELF HUGGING UP A MUSHROOM.."
"..IT WAS NO GO!!"
A MUSHROOM IS AN UNREWARDING LOVE.. ?
COLD..
BUT THAT'S NOT THE POINT! THE POINT IS I AM NOT ALL MALES.. I AM A MALE..
THERE IS A DIFFERENCE?
YOU DAMN BETCHA!! I'M DIFFERENT JUST BECAUSE I AM ME! I CAN'T BE JUDGED ON QUALITIES I SHARE WITH MILLIONS OF OTHER CREATURES..
I CAN ONLY BE JUDGED ON HOW I USE THOSE QUALITIES !!!
HOW DID YOUR LITTLE LADY ABSORB THAT PIECE OF INFORMATION.. ??
..IT UPSET THE SAFE RIGIDITY OF HER CURRENT STRAIN OF LOGIC..
IN OTHER WORDS..?
IT PISSED HER OFF!!
YOU CANNOT DESTROY MY LIBERATION WITH A SEXIST RATIONALIZATION!!
"SHE SCREAMED.."
I AM SO EQUAL TO YOU I AM MORE EQUAL THAN YOU!
WHAT?
"I SAID.."
I AM LIBERATED!! FREE AT LAST TO PUNISH YOU AND ALL YOUR FELLOW OPPRESSORS!!
..AND THERE IS NOTHING I CAN DO TO PREVENT THIS!! ??
NOTHING!!
THAT IS NOT ENOUGH!!
..BUT WE LOVE EACH OTHER!!
I FEEL SAD FOR YOU..
" I STARTED TO LOSE MY TEMPER"

..I RESENT YOU FEELING SAD FOR ME!!
SINCE I'M THE OPPRESSOR, I CAN DO ANYTHING I WANT! I HAVE DECIDED TO BE SAD FOR YOU..
".. WITH MY TEMPER LOST, MY ABILITY TO REASON FLED.."
I RAVED ON ABOUT THE PATTERN OF OPPRESSION THROUGHOUT HISTORY.. HOW THE OPPRESSED CONSTANTLY OVERTHREW THE OPPRESSOR.. ONLY TO BECOME A GREATER OPPRESSOR THEMSELVES.. ROME GAVE WAY TO CHRISTIANS WHO SLAUGHTERED MILLIONS, THE CZAR FELL TO ALLOW STALIN .. THE WESTERN POWERS CRUSHED GERMANY..
..WHO, IN THEIR OPPRESSION, RAISED HITLER .. KING GEORGE III TO NIXON .. A FULL CIRCLE OF STUPIDITY..
WELL.. SHE WANTED TO KNOW WHAT THIS HISTORY LESSON HAD TO DO WITH OUR RELATIONSHIP..
HISTORY TELLS YOU THAT WHEN YOU DEFINE YOURSELF AS OPPRESSED, YOU INESCAPABLY BECOME AN OPPRESSOR! BANG!! THAT'S IT!! YOU ARE NOW A CONDITIONED RESPONSE! A REAL SLAVE!!
IS THAT SO?
" I WAS REALLY ON MY HIGH HORSE NOW.."
YES! THAT'S SO!! YOU ARE FREE ONLY TO REACT TO OTHER CONDITIONED RESPONSES!! YOUR SO-CALLED LIBERATION JUST DUMPS YOU INTO A SPINNING CYCLE OF HOSTILITY THAT WILL EVENTUALLY TEAR YOU TO PIECES!!
YEAH! WELL UP YOURS, BUSTER!!
..THAT WAS THE END OF THE DISCUSSION ?? "UP YOURS, BUSTER!!" ??
..SHE DID SAY A LOT OF OTHER THINGS.. BUT THAT WAS THE NICEST..
WELL.. I SURE DON'T HAVE ANY ANSWERS..
I DO!! HOO HOO HOO
OH NO!
HOORAH! THE LESSER HOO HOO
HOO HOO WHO?
YOU BOTH ADMIT YOU LOVE EACH OTHER.. THAT'S ONE PER CENT OF THE BATTLE WON..
..HERE IT COMES..
..ONLY ONE PERCENT!! THAT LEAVES US NINETY NINE TO GO!!
..ONE PER CENT OF SOMETHING IS BETTER THAN NINETY NINE PER CENT OF NOTHING..
HERCULES, WHEN VIEWING THE RIPE STABLE AND TONS OF HORSE EXHAUST SAID, " THIS, TOO, SHALL PASS.."
HERCULES SAID THAT?
WHY NOT..?


-SO I'M JUST SUPPOSED TO SIT BACK AND ENDURE? THIS IS A LIFE? ALL THAT HOSTILITY!
ROGER.. I AGREE WITH YOU.. ANGER IS ADDICTIVE!! NOT FUN!!
HE DOESN'T HAVE AN ANSWER..
..BUT LOOK AT HER SIDE.. SHE DOESN'T WANT TO BE STUCK WITH ALL THAT WORK EITHER..
SERVANTS! I NEED SERVANTS!
..HE HAS A COMPROMISE..
..SO YOU HAVE TO COMPROMISE AND PUT UP WITH EACH OTHER..
OR QUIT..
..BUT THEN I'D HAVE A SERVANT PROBLEM..
..WHICH IS ONLY HALF AN ANSWER..
..MAYBE YOU SHOULD QUIT WHILE YOU ARE AHEAD.. SAIL OFF WITH YOUR ABILITY TO FORM A ONE PERCENT RELATIONSHIP..
ONE HALF OF AN ANSWER ONLY SOLVES ONE HALF OF A PROBLEM..
..STEALING MY LIQUOR.. SCRATCHING MY STEREO RECORDS..
FRED?
SO YOU COMPROMISE AGAIN AND SOLVE HALF OF THE REMAINING HALF PROBLEM..
NOW YOU HAVE ONE FOURTH OF A PROBLEM..
MAYBE NEXT TIME YOU'LL MEET A LADY THAT YOU CAN HAVE A TWO PERCENT RELATIONSHIP WITH..
..AND ON AND ON AND ON.. UNTIL YOU FINALLY MEET THE PERFECT MATE!
..EATING MY TWINKIES!
FRED! I HAVE A PROBLEM!
-SO YOU WHIP OUT THE OLD COMPROMISE AGAIN.. AND CUT THE ONE FOURTH PROBLEM TO A ONE EIGHTH PROBLEM.. FROM ONE EIGHTH TO ONE SIXTEENTH.. THE PROBLEM IS GETTING SMALLER..
..OF COURSE, BY THEN YOU'LL BE A HUNDRED AND SEVEN YEARS OLD, AND IF YOU WINK AT HER YOUR BLOOD PRESSURE WILL BLOW YOUR BRAINS OUT..
..BUT IT WON'T GO AWAY!! IT WILL NEVER GO AWAY!! ..SOON IT HAS BECOME A TINY HOT NEEDLE DIGGING IN YOUR BRAIN!! DRIVING YOU CRAZY!! "WASH THAT CUP, HAROLD, OR I'LL KILL YOU!!"
..THIS SICK BUG IS BUGGING ME, FRED."
THEY CAN HAVE MY OREOS.. BUT NOT MY TWINKIES!
..BUT YOU'LL FINALLY HAVE A SMILE ON YOUR FACE WHEN THEY BURY YOU..
I HAD A DREAM ONCE ABOUT A MAN WHO LIBERATED ALL THE WOMEN IN THE WORLD..
UAK!
BUG OFF, SICKIE!
SMAP
..HE WENT OUT ONE NIGHT WITH A STICK AND BEAT ALL THE OTHER MEN IN THE WORLD TO DEATH..
GROWN
WHO DID?
WHO DID WHAT?
..BEAT ALL THOSE GUYS TO DEATH..
THE GREAT LIBERATOR
OH..
O'REILL

Nomadics

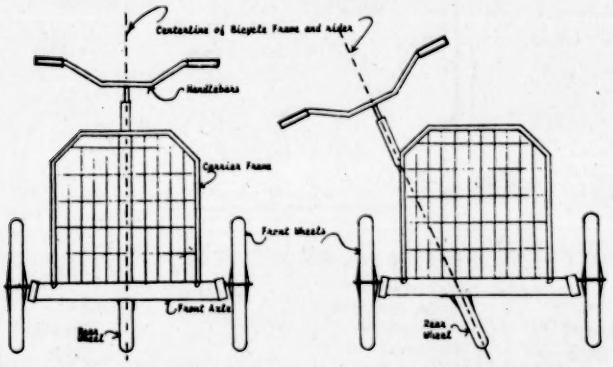
Canada Bike

This is the first well-thought-out three wheeler I've seen. It seems obvious that if bicycles are to really take the place of many autos, machines such as this one will be the way to go. This one even banks in corners and folds to fit car trunks. A happy user speaks below.

—J. Baldwin
[Suggested by Andi Bartnek]

Canada Bike
$295.00 with basket
(can also be electrified)

from:
Canada Bike Co. Ltd.
837 2nd Ave. SW
Calgary, Alberta, Canada



In the "Trike" position, the Canada Bike is rigid and stable so it can be ridden whether you know how to ride a bicycle or not.

In the "Bike" position, the Canada Bike is free to lean so it behaves and feels just like a standard bicycle.

I've used it for packing groceries, 50 lb. bags of manure and dog food, kids, adults, huge bags of laundry — whatever you can think of. It adjusts easily and quickly so my 7 year old can ride it and two minutes later I can be off on it. It's an ideal urban vehicle — or even suburban. It doesn't replace my 10-speed for fun and enjoyment — but it makes the chores and shopping more fun. Buy one with a friend — these bikes are designed to be *used*, not just bought to have sitting around. You won't be able to keep the neighbors, kids and friends off of it for long — they're really great!

—Andi Bartnek
Calgary, Canada

Bike mouth & superbike

Greetings,

I've seen more written and less said on bike safety than 'most anything else about cycling. I've found that the trick to staying alive on a bike during the day, is knowing how to use the old vocal cords, with all the stops out.

It works with dogs as well as nutty drivers. Simply let anything and everyone who gets in your way know you're alive. Knowing the right words won't hurt either, I can blame maybe half of my accidents and close calls on just being reticent.

Another trick I've used, for people who cut in front of you, open their car door in your face, etc., is to give their cartop a good whack with your hand. Very effective.

So you say that all this yelling and cursing and carrying on isn't giving cyclists a very good reputation. All I can say is that dead cyclists aren't doing much for the sport either.

How about using hand signals, stopping for stop signs, and the rest of that crap? Do it. It shouldn't be so difficult, it will avert a few accidents, and besides, if you live through a car-bike accident, you often can't sue if you were breaking any laws or rules. So read up on the rules.

In the EPILOG, Lloyd Kahn said you'd be interested if someone found a "Superbike."

My idea of a "Superbike" is a cheap, safe, and efficient machine that you'd want to keep and ride forever. Of course there aren't any "Superbikes" commercially available (though the new Japanese bikes appear to be the best "ready-builts" for the money). This means that you'll have to build one. This will take a day or two, and cost about $300 - $600. Before you buy anything though, make sure all the necessary parts are available.

Here are the most useful bike catalogs I've found:

Free from:
Palo Alto Bicycle Inc., 171 University, Palo Alto, CA 94301
Here's where you should buy your tubulars; best prices and selection available. They also carry some hard-to-find stuff like crank parts.

$1.00 from:
Bikecology, 3006 Wilshire Blvd., Santa Monica, CA 90403
Just what they say, "The World's most complete bike catalog." They carry practically all of the new Japanese parts, which are much cheaper than their European counterparts, and, in my opinion, are just as light, safe, and durable.

$3.00 from:
Cyclo-pedia, 311 N. Mitchell, Cadillac, MI 49601
I'd get this one for the information alone, but most of their prices are the lowest I've seen.

Also, you might write Bike & Hike of Wisconsin, 7217 W. North Ave., Waukesha, WI 53186 for information on their Ron Kitching framesets. These are cheap, functional frames, probably the best for the money (selling for $150-170).

Some asides: . . . if a frame says "Reynolds 531," check to see if it says "butted." If it doesn't it uses the cheaper straight gauge tubing.

. . . I guess we've all heard about the Phil Wood line of hubs, etc. They're maintenance-free and have a 5 year guarantee.

. . . That good old Regina Extra (with 13-24 teeth) is the one freewheel cluster I'd recommend. This particular cog ratio offers the following advantages: a) it's light, b) it gives you a wide gear range, c) it's small enough that you can use it with a racing type derailleur, making for very fast and easy shifting. It also necessitates the use of custom built cranks ($64-$74 from Cyclo-pedia). To give you some idea of which chainwheel combination to use, I have 36 x 48 t chainwheels which will get a strong rider on a light bike up 'most any hill imaginable.

. . . those titanium frames are looking mighty attractive, now that the price is coming down ($330 the last I heard).

I guess that's all. Thanks.

Daniel F. Priest
West Salem, Ohio

P.S. The present state-of-the-art in bike lights is the Belt Beacon, $6 from Ampec & Associates, Arcadia Station, Box 15461, Phoenix, AZ 85060. It looks like one of those flashing road barricade lights.

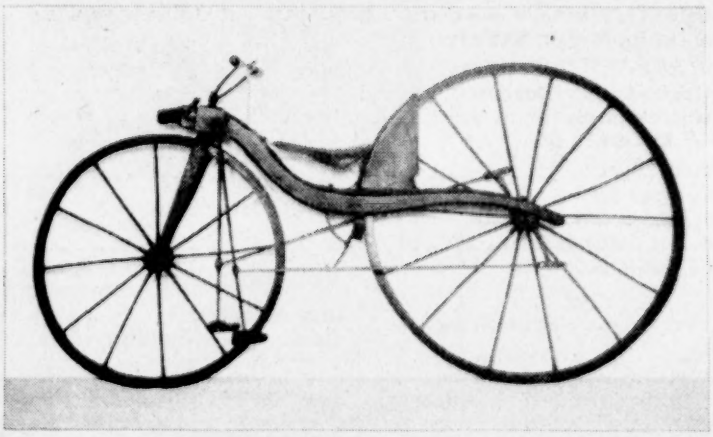
King of the Road

As you might expect, bike people will find this lavishly illustrated history most interesting. But for me the interest comes from the presentation of the bike as a social phenomenon as well as a piece of hardware. Bikes started out being very controversial, and there has been a noticeable class-struggle aspect to them since their invention. This is one of those histories that you can really learn something from as you compare past to present. The book is also an unusually clear look at a developing technology and its impact on the society that must deal with it. There's a good chapter on tricycles too. Trikes are sort of looked down upon these days, but at one time, it was the other way around when they were transport for nobility and bikes were for the proletariat. With trikes beginning a comeback as urban transportation, a look at the past is more than mere idle curiosity. Books like this and Bicycling Science *(CQ Summer 75) are already getting a lot of people into making their own. Good.*

— J. Baldwin

King of the Road
Andrew Ritchie
1975; 192pp
$7.95 postpaid

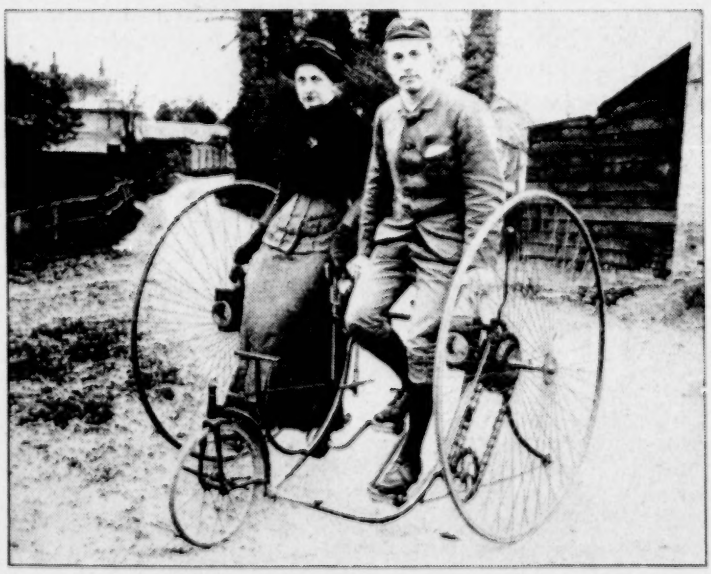
from:
Ten Speed Press
Box 4310
Berkeley, CA 94704
or Whole Earth



A copy of Kirkpatrick Macmillan's velocipede made in about 1860 by Thomas McCall, a joiner and wheelwright of Kilmarnock, who was born and brought up near where Macmillan lived. He sold the velocipedes he made for £7 each.

Note horse head! —JB

•



The 'sociable' tricycle gave women the chance to ride out with their husbands or lovers, but a woman's dress was still hardly ideal for this kind of exercise. A picture taken in the early eighteen-eighties. The machine is a Cheylesmore 'sociable' made by the Coventry Machinists' Company.

Total bike access

Dear Sirs:

Here's a list of the current mail-order sources of bicycle parts and accessories, as noted, some also have bicycles advertised in their catalog and are anxious to ship 'em.

Bike & Hike of Wisc., Inc.
Intl. Div. Dept. A
7217 W. North Ave.
Milwaukee, WI 53212

Send $ .50 to cover 3rd class postage for their 92-page catalog, carry Masi, Cinelli, Fiorelli, Maserati, Benotto, Frejus, Fuji, Jeunet, and Bottechia bikes, all major components, also fine ski-touring line.

Wheel Goods Corporation
14524 - 21st Ave. N.
Minneapolis, MN 55441

160-page catalog: $2. Sells Hosteler, Parliament, Raleigh, Gitane, Kalkhoff, Murray, and Tyler bikes. Most complete catalog I've seen.

Bikecology Mail Order
3006 Wilshire Blvd.
Santa Monica, CA 90403

Send $.30 worth of stamps, advertises the lowest discount prices and they're usually right.

Action Accessories
Box 15
Liverpool, NY 13088

Catalog $1. Has parts for kid's bikes as well as 10-speeds.

Gus Dandos Bicycles, Inc.
16719 Roscoe Blvd.
Van Nuys, CA 94106

Catalog: $2 (refundable on 1st $20 order. Don't yet have this one.)

Cyclo-pedia
311 N. Mitchell
Cadillac, MI 49601

72-page catalog: $3. Xlnt selection, most informative of all catalogs.

Open Air Bicycles
224 Chapala
Santa Barbara, CA 93101

Free catalog.

Bike Warehouse
6187 West Blvd.
Youngstown, OH 44512

Catalog: $.25; very good prices.

Wares
2656 N. 76 St.
Milwaukee, WI 53213

Catalog: $3; Tour de France, Gitane, Windsor, Peugeot, Follis, Raleigh, Italvega, Zeus, Atala, Miyata, Lejeune, and custom built bikes. Good selection of parts.

Bicycles Intl.
Box 601153
North Miami Beach, FL 33160

Send self-addressed envelope for catalog.

Angenieux-CLB SA
P.O. Box 218
11 rue de L'Etienne (Loire)
France

Free 32-page catalog in French, German, and English.

Big Wheel Ltd.
340 Holly St.
Denver, CO 80220

Catalog $2.10. Gitane, Peugeot, Libertas, Flying Dutchman, Legnano, Frejus, Cinelli, Masi bikes. Top selection of parts, tools, etc.

Custom Specialities
11100 Pangborn Ave.
Downey, CA 90241

Catalog: $ .31 in stamps, 14-pages. Handles the essentials at Xlnt prices.

Biking & Hiking
5144 Peach St.
Erie, PA 16509

Free list of bike parts and camping gear.

Ecology Enterprises
510 North Church St.
Naugatuck, CT 06770

Free 13-page list of accessories.

Sink's Bicycle World
816 South Washington St.
Marion, IN 46952

$2 for their catalog.

Touring Cyclist Shop
Box 4009
Boulder, CO 80302

Free brochures; probably make the best panniers anywhere.

Walt's Bicycle Shop
1203 Rogers
Columbia, MO 65201

13-page catalog: $.50; mail-orders Raleighs and others.

Kettering Bike Shop
3120 Wilmington Pike
Dayton, OH 45429

Catalog: $1, refundable w/$10 order.

Hi-E Engineering, Inc.
1247 School Lane
Nashville, TN 37217

Send $ .24 postage for catalog.

Pleasant Valley Shoppe
Box 293
Livingston, NJ 07039

Catalog: $1.

Malibu Cyclery
22524 Pacific Coast Highway
Malibu, CA 90265

Send large self-addressed stamped envelope for catalog.

House of Wheels
8560 Main St.
Williamsville, NY 14221

Catalog: $1.50.

Bikeways Mail Order
2299 Booksin Ave.
San Jose, CA 95125

Free catalog, nice prices.

Dobi
Box 5071
Santa Monica, CA 90405

Unusual but desirable accessories, catalog $1.

[more →]

Hi-Country Bicycle Works
701 W. Hampden
Englewood, CO 80110

Catalog: $1. Only source I've found for Milremo stuff and wide-range chainwheels (26-68 teeth). Many other things found nowhere else.

Recreational Equip., Inc.
1525 - 11th Ave.
Seattle, WA 98122

Free price list; low prices plus approx. 10% dividend for members. Gitane, Carabela, Tiger, and Crescent bikes.

Following is a list of pannier manufacturers or outlets. Many of the lines are available through backpacking suppliers, camping catalogs, etc., such as L. L. Bean's, EMS, AYH, etc., besides the bigger catalogs listed above.

Cannondale Corp.
35 Pulaski St.
Stamford, CT 06902

Panniers, handlebar bags, seat bags, backpacks, and a 2-wheel trailer, the best available, free catalog.

Bellwether
1161 Mission St.
San Francisco, CA 94103

Free information on seat, handlebar, and pannier bags, backpacks, poncho and rainhat. Wide selection.

Touring Cyclist Shop
Box 4009
Boulder, CO 80302

Expensive, but the best. Free info. Zip together to form luggage, or can be easily mounted on a pack frame.

Kirtland/Tourpak
Box 1459
Boulder, CO 80302

Big pannier and handlebar bag, free catalog, dealer list and mail-order information. Panniers zip together and HB bag has a shoulder strap.

Open Air Bicycles
224 Chapala St.
Santa Barbara, CA 93101

Free information on the lightest bags made.

Leisure Marketing
Suite 350
119 Paul Drive
San Rafael, CA 94903

Don't know if they have a catalog, check Bicycling *or* Bicycle World *magazines.*

Recreational Equipment, Inc.
1525 - 11th Ave.
Seattle, WA 98122

Cheapest available, free catalog.

Blacks
930 Ford
Ogdensburg, NY 13669

Karrimor bags and panniers, big bags, free catalog.

AYH
132 Spring St.
New York, NY 10012

Camp Trails, Bellwether, Cannondale, and Karrimoor bags and panniers. Free catalog.

Dobi
Box 5071
Santa Monica, CA 90405

Phillips brand of bags. Free catalog.

Frostline Kits
Dept. C
452 Burbank
Broomfield, CO 80020

Kits only, but they're cheaper and easy to do; I know, I did their panniers. Nice features, plus the option of customizing 'em as they go together. Luggage and handbag capabilities. Free catalog.

Gerry
5450 North Valley Hwy.
Denver, CO 80216

Famous mfg. of backpacks, panniers, etc. Free catalog.

Holubar
Box 7
Boulder, CO 80302

Free cat., Carikit line of assemble-it-yourself of Holubar quality bikebags.

I. Goldberg
2nd and Market St.
Philadelphia, PA 19106

Champion line of bags & panniers. 200-pg catalog $1.

Following is a list of bicycling or related organizations with a brief description of each.

AYH (American Youth Hostels)
National Campus
Delaplane, VA 22025

Also check your Yellow Pages, offers places to stay for $1 - $2/nite, insurance, Eurail Passes, car leases & purchase in Europe, guidebooks and directories, & camping, biking, canoeing, etc. equipment. $10/yr (18 and over).

International Bicycle Touring Society
846 Prospect St.
La Jolla, CA 92037

For ages 20 - ?. Tours are accompanied by a sag wagon, pace is slow. Aimed at Middle America. $5/yr.

L.A.W.
19 S. Bothwell St.
Palatine, IL 60067

League of American Wheelmen. Lobbyist, educator, for bikers, also provides technical, map, touring, information. $5/individual, $8/family/yr.

Amateur Bicycle League of America, Inc.
Box 669 Wall St. Stn.
New York, NY 10005

"Governing Body of Amateur Cycling in the U.S." If you're into racing, get into this.

Your welcome,

Jon Adams
Beaver Falls, Pennsylvania

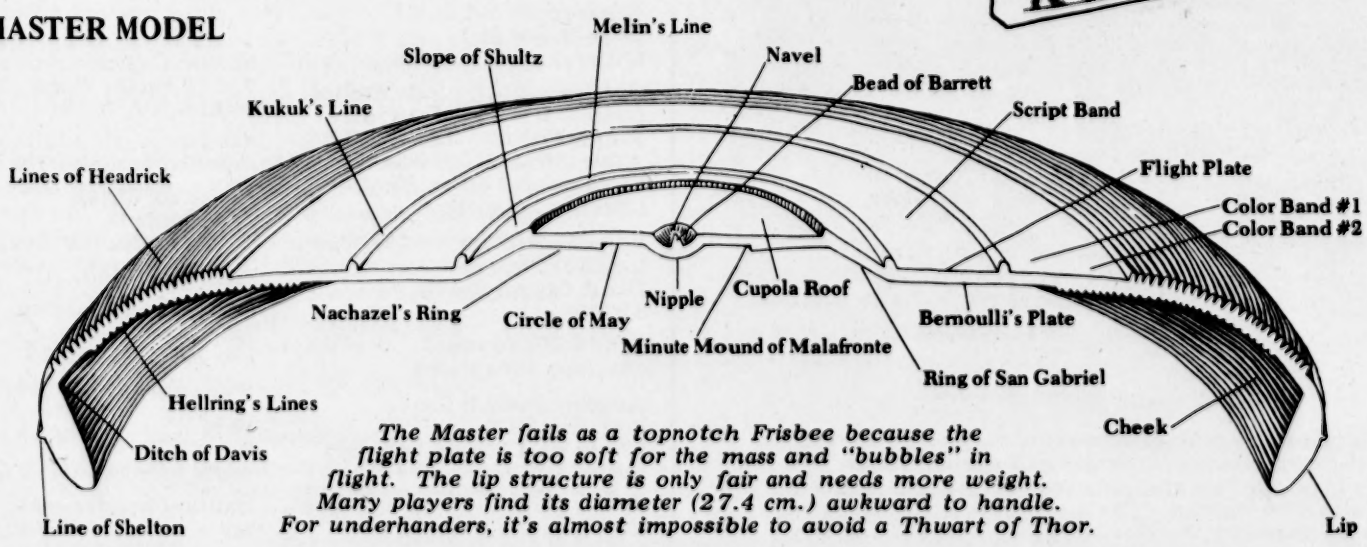
Frisbee

A Frisbee is an innocent, simple thing to have around, like a ball. Nonetheless, there lurks in our midst very serious Frisbee freaks who have developed the phenomenon into a fine art. This text tells everything you might want to know about the Frisbee, and very likely a lot you might not want to know. Nicely done, and amusing too.

—J. Baldwin

Frisbee
(A practitioner's manual and definitive treatise)
Dr. Stancil E.D. Johnson
1975; 221pp.
$4.95 postpaid
from:
Workman Publishing Co., Inc.
231 East 51 St.
New York, NY 10022
or Whole Earth

MASTER MODEL

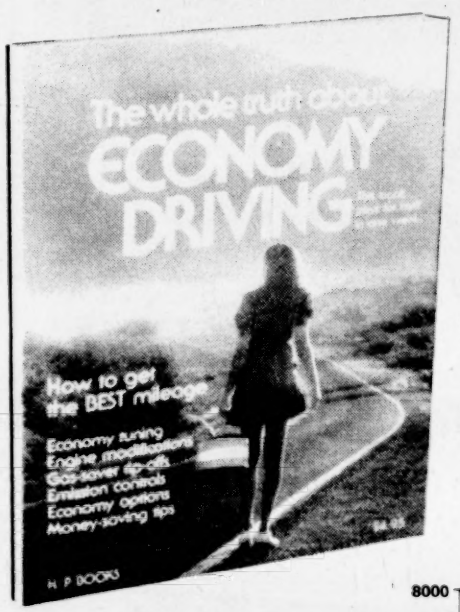


The Master fails as a topnotch Frisbee because the flight plate is too soft for the mass and "bubbles" in flight. The lip structure is only fair and needs more weight. Many players find its diameter (27.4 cm.) awkward to handle. For underhanders, it's almost impossible to avoid a Thwart of Thor.

Economy Driving

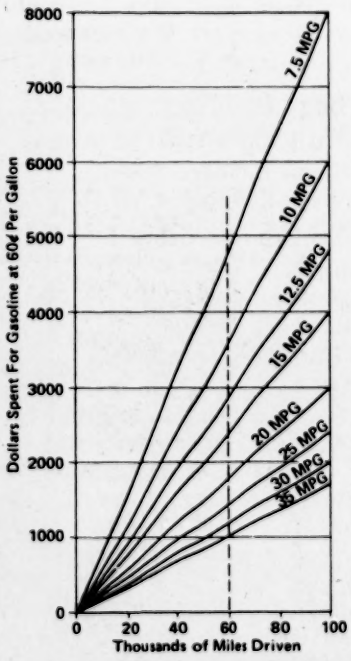
Most books making claims of this sort merely tell you not to jab the gas pedal so hard. This one, which is certainly the best we've seen, covers virtually every money-eating aspect of owning a car. Buying it in the first place is included. With the Average American Car costing its owner about 18 cents a mile to run these days (!) every little thing counts. The book is exceptionally well detailed and illustrated, and covers just about every little thing you could think of. The cover immodestly claims that you'll save the cost of the book in a week. You probably will, plus a lot more.

—J. Baldwin



The Whole Truth About Economy Driving
Doug Roe
1975; 174pp.
$4.95 postpaid
from:
H.P. Books
Box 5367
Tucson, AZ 85703
or Whole Earth

On a cold start, you'll serve both your wallet and your engine better if you just warm up long enough to get the oil flowing and the engine willing to move the car. Then drive conservatively for a few miles without lugging or racing the engine, while it is getting the rest of the chill out of its bones. You will get it off automatic choke sooner by driving than by letting it sit there and idle.



Le Truck

On Tahiti, most public transportation is effected by vehicles known as "Le Truck." These are flatbed trucks with park benches running down each side and a roof covering the whole kaboodle. Entry is up the rear bumper. Side curtains can be let down in case of driving rain. Le Trucks have no set schedule. You wait until one appears and then get on it for about 40 cents (US) and ride until you get about where you want to be. Some just cruise around the city. Others go all the way around the island. Many seem to be owned by individuals much as taxis are here. It seems to work pretty well. No big bureaucracy with huge capital outlay for garages, mechanics, insurance, union contracts, vehicle fleets and retirement funds. Just a bunch of modest machines going where people want to go. They do it in Mexico too. Would it work here? I'll bet it would.

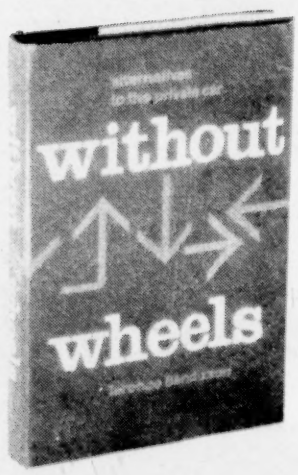
—J. Baldwin

Without Wheels

Sooner or later, the internal combustion engine, and the car as we know it, have got to go. The question is, how and when? The wreckage of our cities must be reversed and the car's parasitism on the social bloodstream somehow ended. This book by a British writer amasses a large amount of modestly relevant information, and proposes a mixed approach, assuming the auto will never be killed through some blinding single stroke of invention, but rather through a slow process of slow attrition and transformation — i.e., the same way it achieved its present dominance. The central techno-social problem is, of course, that the auto-highway combine has passed the enormous costs of car-based transportation on the public in largely hidden and diffused ways, while any new alternative always has to be presented with more or less open figures — and losses.

But from Bendixson's worldwide survey we learn that we are not alone: many ingenious and workable schemes to combat the Curse of the Car are being hatched everywhere. Traffic control zones to make it harder, not easier, to drive into central areas where cars are already too numerous; dial-a-ride and similar systems that are halfway between taxi and bus service; the ancient and honorable jitney; train and bus service designed to help turn cities back into compact, walkable, sociable places instead of catering to suburban sprawl; tax and licensing policies that end subsidization of cars at the expense of other modes; experiments with computer-billed individual-driven taxis in downtown areas; all-day tickets for frequent riders. And so on — in Britain, Sweden, France, Saskatchewan, even the USA. "It is no longer a foregone conclusion," writes Bendixson, "that cars will inherit the earth." Since our alternatives to cars are about the most underdeveloped among industrial nations, American readers have a lot to learn from him — as we continue what is bound to be a struggle on many fronts.

—Ernest Callenbach



Without Wheels
(Alternatives to The Private Car)
Terence Bendixson
1974; 256pp.
$7.95 postpaid
from:
Indiana University Press
10th & Morton Sts.
Bloomington, IN 47401
or Whole Earth

Dial-a-Ride

The prospective traveller rings a dispatching office, places an order for a trip, gives his name and address and at the time appointed a minibus with a radio telephone on board is waiting at the door. Some riders will already be in their seats and others will be picked up in turn at their front doors, on the way to the shops, the works, the hospital, the station or whatever. . . . Dial-a-ride is a bus and taxi hybrid. It gives a better quality of service than a bus but undercuts taxis in cost. Naturally, it attracts the antagonism of both. In Ann Arbor, Michigan, both the transportation authority and the Ford Motor Company were taken to court in 1971 by local taxi operators for having the effrontery to announce a dial-a-ride service. Fortunately for the people of the town, first Washtenaw County Circuit Court and then the Michigan Court of Appeals found against the taxi men.

•

. . . a Morris Mini doing forty miles to the gallon and carrying four people will be more economical than a twelve-miles-to-the-gallon coach carrying twelve. Less fuel would be burned if the coach party was sent off in three minis.

Alden Shell

The ultimate rowboat is the rowing shell. They have a sliding seat that greatly increases your rowing power by utilizing the strength in your legs too. They're twice as fast as a conventional rowboat, which makes them about the fastest man-powered watercraft if you don't count racing machines. Very good, quiet exercise, and useful in bigger waves than you might think. They're to water transportation what a good 10 speed is to land, with similar attitude and usefulness. Here's one maker of good repute. Their sliding seat assembly is available separately for installation in other crafts.

—J. Baldwin

Alden Ocean Shells
about
$600.00 complete

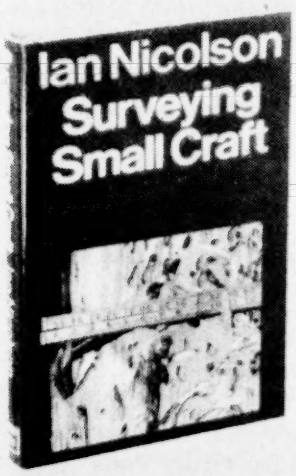
from:
Martin Marine Co.
Box 251 Pepperrell Rd.
Kettery Point, ME 03905

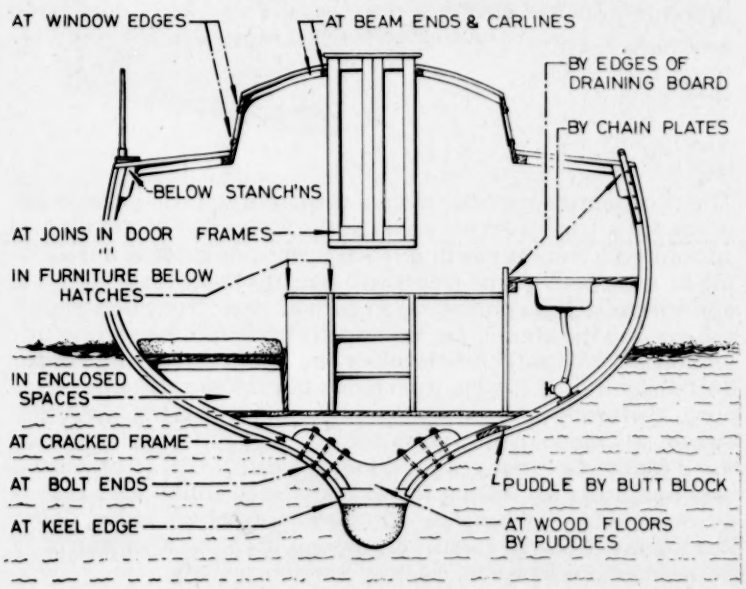
Surveying Small Craft

Those of us hankering for a boat are most likely to make one or buy a used one. Buying a used one is very tricky. "Surveying" is what hiring a specialist to look it over is called. You can do some of it yourself (though it isn't a job for amateurs) and save money. This book tells how. It's written by an Englishman, and there's a note of translation by an American surveyor to explain things that might not be clear otherwise. If you're thinking of adding a boat to your life, this is required reading.

—J. Baldwin

Surveying Small Craft
Ian Nicholson
1974; 224pp.
$9.95 postpaid
from:
International Marine Publishing Co.
21 Elm St.
Camden, ME 04843
or Whole Earth





A search should be made for rot wherever water can become trapped, and particularly where rainwater can seep in. This sketch shows typical vulnerable areas and suggests other comparable danger spots. For instance, stanchions work loose so that rain and spray gets down through their bolt-holes. The same trouble occurs at other deck fittings, especially those which take a lot of punishment.

Boat Building With Plywood

The welcome and increasing interest in hand-making things from wood will sooner or later turn many to boatbuilding. It's a skill that soon develops an attitude in the craftsman that can be transferred to other disciplines, housebuilding for instance, with great advantage. This book is sort of a beginner's introduction; real diehard wood boat builders frown on plywood. On the other hand, it's the fastest and easiest way to make a serviceable small boat. Very clear instructions with lots of drawings and photos. The publisher also has a host of other how-to books of similar merit on subjects ranging from boat trailer building to fiberglassing.

—J. Baldwin

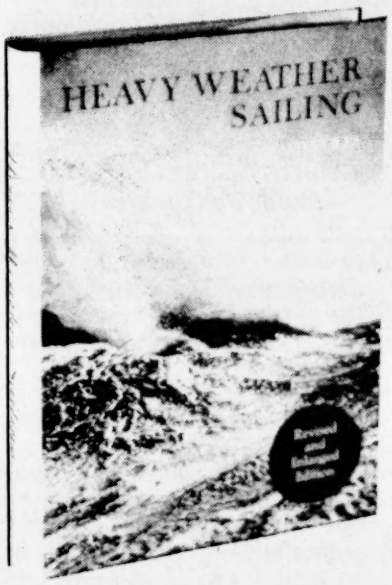
Boat Building With Plywood
Glenn L. Witt
1962; 214pp.
$8.95 (hardcover)
from:
Marine Designs
9152 Rosecrans
Bellflower, CA 90706

To fit the area up forward where the bottom and side will meet in a butt-joint, the sharp edge of the side planking is coated with a crayon, chalk, or grease pencil. By bumping the bottom panel down, a line will be transferred to the outerside of the bottom panel.

Heavy Weather Sailing

Collected experiences of those who have survived "survival storms". Guaranteed to make the let's-get-a-boat-and-sail-around-the-world crowd think at least twice. Mostly experiences; not so much advice. On the other hand nobody knows what didn't work, so this may be all there is to say. Incredible photographs. Meteorology too.

– J. Baldwin



Heavy Weather Sailing
K. Adlard Coles
1967, 1975; 328pp.
$15.00 postpaid
from:
John De Graff, Inc.
34 Oak Avenue
Tuckahoe, NY 10707
or Whole Earth

"*Sayula II* was on the face of the wave when the falling crest caught the stern first, forcing it down the wave faster than the bow. With the bow gripping the water and the stern in the falling water, the boat slewed around almost broadside on to the wave." In other words she broached to. "And then the wave broke. The boat literally fell – no one knows how far." Judged later by the trajectory of fallen articles and by other evidence the angle of the capsize must have been between 155 and 170 degrees from the horizontal, which is nearly upside down . . .

Down below there was a shambles of displaced mattresses, clothes, bedding, bunkboards, floorboards, tins, and provisions liberally sprayed with chicken noodle soup and salad oil, so slippery as to make even standing hazardous. Everything that could move did move, and one crew member was temporarily buried under the lot. Out of the crew of 12 in this large yacht there were six casualties; two with broken ribs, one with a torn shoulder, one with concussion, one with an injured leg and one with aggravation of an old back injury.

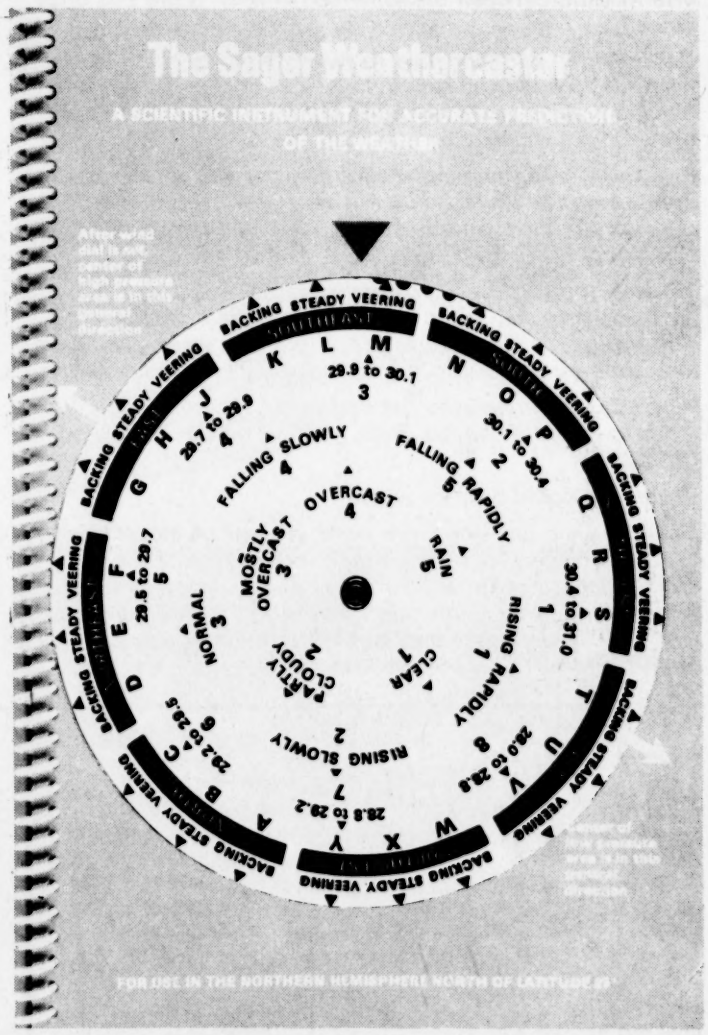
Ultimate Storm. This incredible picture was taken by Captain de Lange in a North Atlantic gale of about Force 10/11, between 35 and 45 N. Seas such as are depicted are experienced by freighters on the West Indies about once in four years, and hence might not be encountered by a yacht even in a lifetime of voyaging. The picture shows the height seas can attain. A yacht might ride the huge sea in the foreground but look at the 'freak' wave coming up astern.

Sager Weathercaster

This clever, proven kit enables you to forecast local weather up to 24 hours in advance. All you need is a barometer and the kit; no radio, TV, or newspaper. The kit consists of an explaining booklet (which includes photographs of cloud types) and a sort of circular sliderule that you set according to observed conditions and read out the prediction. Looks to me like a great way to learn about weather patterns too. It'll only work for latitudes north of 25° N.

–J. Baldwin

The Sager Weathercaster
Raymond M. Sager
1942; 26pp. plus device
$7.95 postpaid
from:
Weather Enterprises
P.O. Box 473
Pleasantville, NY 10570
or Whole Earth



Good grub(s)

In reference to your bit about insect food in the **Whole Earth Catalog**.

I was born in South Africa and ate white ants quite often – taste like nuts – they are good just as they come or fried, then a delicassy. These are not the same as termites but termites are good also. Your Science Digest recipe sounds good but not with ants! Ants have acid on their feet and will burn the tongue – try one! It would be too laborious to remove legs first.

If you want to know what to eat in the veld simply follow a pack of baboons or better yet a pet baboon on a leash. They find something every couple of feet even in semi-desert.

May you find,

John Williams
Kingston, Ontario

The Art of Bodysurfing

I like this book, written by Presiding Justice Robert Gardner of the court of appeal at San Bernardino. It's terse, knowledgeable, thorough, informative, and agreeably written. I learned a lot, reading it [though I can't refrain from correcting: Makapuu is deprived throughout the book of its final "u"; and "Kaha Halu" is not the Hawaiian for "bodysurfing," "kaha nalu" is (and it means, literally, roughly, "draw a line in the surf").]. At any rate, he tells of many wonders:

History: Gardner surfed Balboa Pier in the late twenties, and he's evidently soaked up his money's worth since, of observation and experience. Learn how bodysurfing gave John Wayne to the movies.

Waves and surf: How waves come to stand up. The greatest wave even measured by man. And Gardner insists on pre-immersion squat-and-study, so (among other things), you don't go out for the three-foot sweeties playing the intermission between the nine-foot killers. (I did this once. Once.)

Equipment: knowing how to swim. What to wear. For men, why not to bodysurf naked, ha ha. Wetsuits. Fins: make, fit, and how to avoid having to search for yours on the beach the morning after a big day.

Bodysurfing for beginners: Considering that what Gardner does cannot be done, he does it very well. His instructions are clear, explicit, and thorough. The man knows what he's doing.

Modern bodysurfing: surfing different breaks. Cutting. Big Surf. How to stay out of trouble, or handle it if you can't. The trough, oh God. How to pull out of a wave, avoiding a long thumpy shoreward tumble until the white water subsides.

Where to: an impressive list of places he's been himself, Atlantic & Pacific coasts, Baja, Mexico, and (natch) Hawaii. China!

If only we could breathe water.

Dear Stewart, just one more word, please? A moral lesson. "Bodysurfing will always be the supreme test of man's age-old struggle to conquer his most ruthless, dangerous, and implacable enemy — the sea." Happily, this wrongheadedness doesn't permeate the book. But dammit, why do so many surfers of all varieties hold to the notion that when they have successfully and lyrically hitched a ride from the great ocean by virtue of alert sensitivity to what the wave was going to do, with him on its shoulder or without him — why do these surfers fancy that they have conquered the wave? I loved bodysurfing at Makapuu because I mumbly inarticulate loved it. But I also was pleased to think that by bending myself to the waves I was tuning up not just my body but my world view. Americans believe in conquest, and I am an American, so I rejoiced to think as I flapped my Churchills against my thighs, heading into the water, that my friend Makapuu was gonna wash that taint right outa my hair, at least some. A day spent sliding in and paddling back out, over and over, was a varied, unremitting manifestation of the lesson that if I did not fit my way to the way of the tao, I would suffer — if only from a shore-break skinned knee. But if I yielded in a lively way, I had rushing green translucent heaven.

—Judith Van Slooten

The Art of Bodysurfing
Robert Gardner
1972; 83pp.
$2.95 postpaid
from:
Chilton Book Co.
Sales Dept.
Chilton Way
Radnor, PA 19089
or Whole Earth

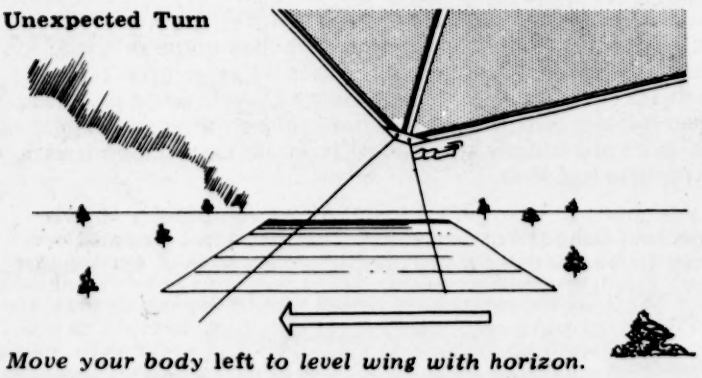
Sometimes the waves wall up so critically that they hollow out, and the surfer who is screaming along the face of the wave in a tight cut finds himself in a free fall. This time you simply roll yourself into a tight tuck position, take a long breath, and prepare to battle for your life. This is where you'd better be in good condition. Be sure to hold your breath tight because otherwise, even in a tight tuck, the wind will be knocked out of you. When you hit, you head for the bottom — if you are not already there — then shove off out to sea and try to get beyond the turbulence and into the green water.

Hang Flight

Tells you how to hang-glide and stay in one piece. Now the best instruction manual. It's enough to boil one's blood.

—J. Baldwin & SB

Hang Flight
Joe Adleson and
Bill Williams
1974; 96pp.
$3.25 postpaid
from:
Aviation Book Co.
555 W. Glenoaks Blvd.
Glendale, CA 91202
or Whole Earth



Move your body left to level wing with horizon.

1976 Charter Flight Directory

For two bucks this pamphlet lists thousands of flights and tours that you can take advantage of without being a member of any special organization. It's possible to save more than half! All perfectly legal and safe too. If you plan to do some travelling, better look into this. Charters are for domestic flights as well as overseas.

—J. Baldwin

1976 Charter Flight Directory
Jens Jurgen
1975; 24pp.
$2.00 postpaid
from:
Travel Information Bureau
P.O. Box 105
Kings Park, NY 11754

Generally speaking, charter flights cut air travel expenses in half by offering only efficient full plane service. By comparison, regular scheduled flights fly—on the average—with about 50% of all the seats empty. This waste is, of course, reflected in correspondingly higher fares for regular individual travel.

If you can commit yourself to travel both ways on specific dates and between specific cities for which a charter flight has been scheduled, and you are reasonably sure you won't have to cancel this trip at the last minute, then a charter flight may be your best travel buy.

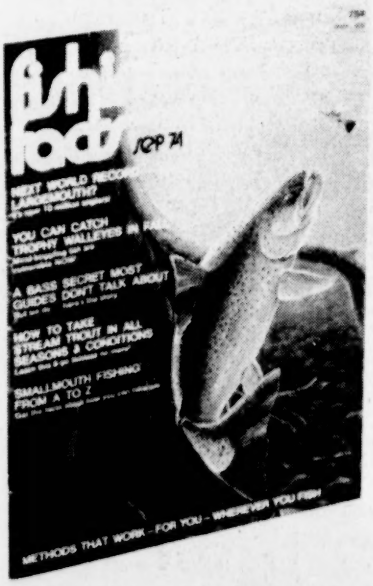
Structure Fishing

I am thinking your readers might be interested in information on a few very good and interrelated sources concerned with fishing skills. I am enclosing a copy of **Fishing Facts** magazine and further suggesting two books: **Spoonplugging** by Buck Perry and **Lunkers Love Nightcrawlers** by the staff of the magazine. They follow a technique which they call "structure fishing." This method involves a few basic gestures towards finding the structure on a lake (structure is approximately that area of the bottom which supports fish) as well as a knowledge of weather conditions (for instance, cold fronts drive fish to the deep waters and renders them sluggish as all hell) and the solunar tables (which, through the positioning of the sun and moon, can approximate — with incredible accuracy — the feeding, or general activity times of the fish — or of humans for that matter — check this out — it in itself is amazing.

I suggest these books because it is possible (and quite useful) to look past the trophy-fish mentality (less prevalent here than in most other sources) to an interesting set of facts concerning the habits of fish and fishermen. I've ended up making my own adjustments. For instance, "structure fishing" relies heavily on some sort of depth finder in order to read the bottom of a lake or river. I use a medium sized stone tied to a knotted rope and in this way the heavy artillery is by-passed. Also, it helps, when working through this stuff, to insert your own words, thus "lunker" (jargon for the largest of the game fish) becomes "bass" or just "fish" and "trophy" becomes "dinner." If you're interested in learning the specifics of fishing and the possibilities of catching fish whenever it is necessary, then it's worth the effort to learn structure. Because it works. Consistently.

Thank you,

S. Thomas
Iowa City, Iowa



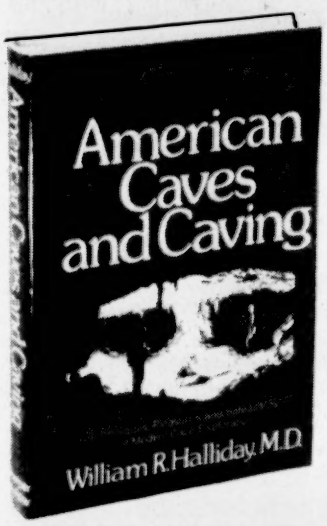
Fishing Facts
George Pazik, ed.
$8 /yr (monthly)
from:
Northwoods Publishing
Box 4169
Milwaukee, WI 53210

American Caves and Caving

Creeping around underground isn't everyone's idea of fun, but it ranks with technical rock climbing and mountaineering, and often utilizes similar techniques and attitudes. Aboveground, there really isn't much left to explore for the first time, especially in the USA. Underground, the opportunities for true exploration are there, with all the risks and possibilities of reward. This book is a very thorough presentation of the latest methods and equipment as well as the expected yarns and war stories. Vertical caving is especially well shown. Beginners might be a bit put off by the author's emphasis on emergencies (he's an M.D.) but considering where cavers cave, a bit of caution is obviously in order.

This book is already considered a classic and will likely remain so until the sport/art develops considerably more advanced techniques.

—J. Baldwin



American Caves and Caving
William Halliday, M.D.
1974; 360pp.
$10.00 postpaid
from:
Harper & Row General Books
Keystone Industrial Park
Scranton, PA 18512
or Whole Earth

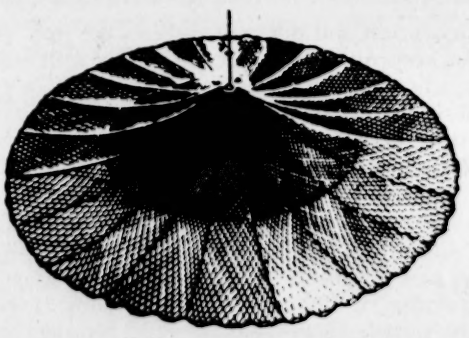
Rimstone pool in the New Mexico Room of Carlsbad Cavern. Note beginning stalagmites at lower left. Unfortunately, drinking from such pools is usually unsafe.

Net

Now that you know where to buy a baffling variety of nets and netting, twine, hoops, etc., what can you do with the stuff? Fishing equipment, obviously, but I'll bet you can think of many uses that even the manufacturer hasn't considered. Often the most appropriate uses of a material arise from designs that could be accomplished in no other way except by the use of that particular material. Knowing what's available is one way to get at it.

—J. Baldwin
[Suggested by Scott Sadil]

Nichols Catalog
from:
Nichols Net & Twine, Inc.
Rural Route 3, Bend Rd.
East St. Louis, IL 62201



Excellent Nets for bait catching, Minnows, Shad, Crayfish, etc. Thrown and operated by one man. Whole schools of bait fish may be captured at one throw. Natural bait caught alive on the spot is always best.

Mesh Sq.	Dia.	Wt.	Price
3/8"	Nylon 7'	4.0 lbs.	$21.00
3/8"	Nylon 8'	4.7 lbs.	22.00

Communications

Boycott the Metric System

The centimeter is unloveable, inhuman, and not even really convenient. It is the chill breath of a vicious Fascist conspiracy. We welcome, therefore, two towering allies in our fight against the Metric which began with Steve Baer's diatribe "Metric System Con" in the Winter '74 CQ.

First, economist and behavioral scientist KENNETH BOULDING, writing in the December 1975 issue of Technology Review*:*

. . . The metric system is a preposterous historical accident, with very little to recommend it but popularity. Its units are arbitrary and it is not even consistently decimal: time is still measured in Babylonian sixties. What's more, the scale of ten is much inferior both to the scale of eight — which at least is binary — and the scale of 12 — which is both binary and ternary. What is so great about five times two? The metric system is the triumph of French revolutionary logic over good, sound folk measures that have psychological meaning. Measures such as the foot, the yard, the bushel, the furlong, and the acre all originate in human behavior. The Celsius scale is just as arbitrary as Fahrenheit and psychologically less satisfying. . . .

The rest of the world is probably right to bully us into adopting the metric system since it's convenient for everybody to tell the same lies. But let us not pretend that the metric system has any scientific foundation and let us not give it the benediction of the scientific community.

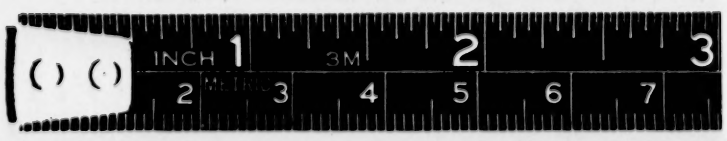
Next, the formidable historian EUGENE ROSENSTOCK-HUESSY in the chapter on France in his opus Out of Revolution *(suggested to us by Richard Baker):*

THE TYRANNY OF THE DECIMAL SYSTEM

We can see this French use of mathematics very clearly in a question of world-wide interest: the decimal system. The fog of avoirdupois and troy weight was dispersed. Water, Adam's ale, was made the cornerstone of the new natural system of weighing and measuring bodies and distances. A thousand grams of water are one litre, and a litre is a cubic-decimeter or 1000 cubic centimetres of water. The metre, again, is in connection with all nature, being the ten-millionth part of a quadrant (a quarter) of a meridian, from the Equator to the Pole. Its standard is a piece of platinum kept at Paris. The grand conception of "nature" could not be better expressed than by this new constitution for nature. The old measures, foot, yard, acre, rule, grain, pint, etc., were all taken from the near environment of man: his own body, his fruit, his soil, served as sources of his language. The French Revolution speaks in the name of nature. It starts from the Equator and brings home one forty-millionth of its circumference for practical use. The idea is universal, the adaptation is made by subdivisions. Man truly becomes a grain of dust on the globe in the same measure that he believes in the metre as one ten-millionth of the quadrant of his planet.

Decimal numeration and decimal systems are not "natural" in the way of common sense. Dozen, score, and hundredweight contradict the hypothesis that ten and five are more natural than 4, 12, 20, and 112 or 120. They are not. Not even the natural logarithm can be based on ten-ten in the abstract. The decimal system ought rather to be called an abstract or reasonable system.

Furthermore, the decimal system reveals the real meaning of "nature" in the French language. "Nature" is not the noble savage, but the reasonable Robinson Crusoe, not the blushing Adam, but the reflecting Voltaire; it should not be called "nature" but "reason," and should be written in capitals: REASON.



On Machine Intelligence

Addresses and essays for the general reader by a Professor of Machine Intelligence at the University of Edinburgh. A biologist working in close association with computers for many years, Michie presents significant issues in an informative, accessible and human style. A major contributor to the field himself, Michie draws on and elucidates work by many members of the artificial intelligence community; the ideas of Hewitt, McCarthy, Minsky, Newell, Turing, Winograd and numerous others are described, references are provided. This book should appeal to a diverse audience. It is a good introduction to the subject and makes excellent tea-time reading.

—Marc Le Brun

Patients in Massachussetts General Infirmary were allowed to converse with the program, after being warned that a computer, not a doctor, was at the other end of the line. Sixty percent of them subsequently rejected this information and insisted that they had been in communication with a flesh-and-blood doctor — "No machine could understand me that well."

•

An early name suggested for what is now "artificial intelligence" was "epistemological engineering."

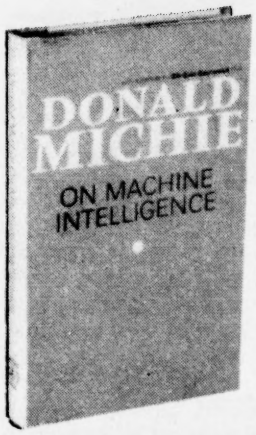
Computer Chess

Although there has been interest in computer chess for almost as long as there have been computers there does not yet exist a program capable of playing at the level of a Master, or even a strong tournament player. That this is the case is illustrative of the nature of the state of the information arts. Chess is a well-defined symbolic system and player ratings a clear-cut performance measure. These qualities make chess a good objective standard for evaluating the degree to which the theories and practices of artificial intelligence are successful. Monroe Newborn's Computer Chess *is a chronicle of the progress to date in this area.*

The presentation is made using over forty actual games, mostly computer-versus-computer, whose descriptions comprise about three-quarters of the book. The bulk of these games was played in the four United States Computer Chess Championships held in the years 1970 through 1973, and the First World Computer Chess Championship in 1974. Also included are Turing's 1951 hand simulation, the 1958 Los Alamos mini-chess program, the first full-scale chess program by Bernstein et al in 1958, the first USA–USSR match, played in 1966, the first game won against a human in tournament play (Mac Hack Six in 1967), and the postal contest between the Soviet KAISSA (currently the World Champion) and the readers of Komsomolskaia Pravda *in 1972.*

This last contest was conducted by selecting the move suggested by the majority of readers. KAISSA lost one, drew one. In a previous contest with the readers Boris Spassky won one, drew one, reflecting favorably on the strength of the program. (Soviet programs have consistantly beaten American ones, a curious fact considering the American advantage in software and hardware.)

At present the computers are strong on tactics, but weak strategically, as the games in the book amply document. There are also a number of amusing bug-ridden games: where the worst move considered was played, where a draw is avoided twelve times in a futile search for a win, and where a program, seeing both a mate-in-one and a mate-in-two becomes so confused that it takes advantage of neither and ultimately loses. A few of the games are of passable quality, most however exemplify the outstanding faults of computer play: strategic consistancy, failure to capitalize on an advantage, a tendency to "stick their



On Machine Intelligence
Donald Michie
1974; 199pp.
$6.95 postpaid
from:
Halsted Press
John Wiley & Sons, Inc
One Wiley Dr.
Somerset, NJ 08873
or Whole Earth

•

. . . it is possible to arrive at misleading conclusions if one presents puzzles, as is the custom of experimental psychologists, to central nervous systems which have been adapted by natural selection to cope with games.

•

. . . we do *not* yet understand either Euclid or cookery: we may possess a kind of instinctual "understanding" of such tasks, analogous to that by which a high-jumper gets himself over the bar or an acrobat balances on a wire, but we have not achieved understanding of the understanding. If we had, we could program it. If we cannot, then although, as *homo sapiens*, we may display this or that capability, we cannot claim truly to understand, in the given respect, what it is to be human.

Calculus Primer

It sometimes seems a bit ironic that it is necessary to have mathematical skills in order to understand certain natural phenomena, but that's how it goes. The necessity of learning calculus keeps rearing its ugly head. For me that meant 4 to 6 hours a night of laborious homework and a rather highly refined hatred. I don't know if this book would have helped me, but I'll bet it will help lots of other folks. Martin Gardener, resident mathematician at **Scientific American** *likes it too, which is good enough for me. If calculus is hanging you up, it might be worth the reasonable price of this book to see if it can unhang you.*

—J. Baldwin

Prof. E. McSquared's Original, Fantastic & Highly Edifying Calculus Primer
H. Swann and
John Johnson
1971; 111pp.
$2.95 postpaid
from:
William Kaufmann, Inc.
One First St.
Los Altos, CA 94022
or Whole Earth

heads in the sand" in the face of a threat (the author's program, which took sixth-place in the World Championship, is named OSTRICH), and a propensity for aimless dithering.

In the remainder of the book not devoted to games and analysis Newborn presents the main techniques used in computer chess and a fairly detailed description of the OSTRICH program. It is these sections which illuminate the more generally germane topics, and, I believe, help explain why computers play (as poorly) as they do.

We are informed early in the book, that "All the chess programs that have ever been written and that are of any significance today are based on Shannon's ideas." These ideas were presented in 1950! Though Shannon is undoubtedly an important thinker, considering the advances made in computer science in general, and artificial intelligence in particular, the adherence to these ideas for a quarter century is remarkable. Briefly, Shannon's paradigm is as follows: the computer "imagines" various moves made from the position currently confronting it, and the positions which result from those moves. It then applies an evaluation function to the resulting positions, thereby determining which are "good" and which are "bad." The various actual chess programs differ in which features of a position are "noticed," what weights they have in the evaluation, and how the evaluation and other factors (available computing resources, time on clock, etc.) affect the generation of "imaginary" positions, and also the way in which the generation is accomplished.

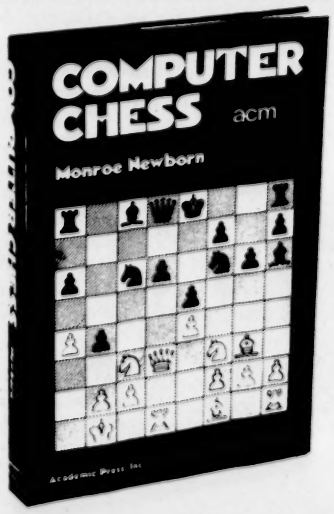
In practice the evaluation is carried out by assigning a numerical value to each of the features of a position that the program recognises, and then adding all the numbers up, the total being the "score" for that position. "Good" features are given positive values, "bad" features negative ones. Whether the sum is positive or negative is intended to indicate which side has the advantage in that (imaginary) position. This is an exaggeration of numerical techniques used by many human players (e.g., assigning values of 1, 3, 3, 5 and 9 to the P, N, B, R and Q, or determining the outcome of an exchange by counting the number of pieces involved on each side).

This technique is subject to several criticisms, not the least of which is that a weighted sum is hardly a sophisticated way of representing the outcome of the interactions of the various board features. Because of this emphasis on highly numerical techniques the designers of these programs are reduced to a crude behavioristic conditioning to attempt to force their programs to follow even the simplest strategic guidelines. Newborn describes in great detail the reward/punishment system used in OSTRICH, for example term 17 of his scoring function is an "Attack Encourager" to wit: "Moves at ply 1 that put an opponent's piece en prise are given a 40-point bonus. This term gives the program an aggressive spirit." Conversely, OSTRICH is "discouraged" from blocking unadvanced center pawns by a 470-point penalty.

A few programs, such as one developed at USC, are appearing which employ more sophisticated techniques, although they have yet to make a strong showing against the older programs. It would seem to me however that the development of really powerful computer chess systems depends on the introduction and implementation of the newer (and as yet unrefined) ideas of artificial intelligence, such as theory formation, in terms of both actual over-the-board situations (modeling and planning) and the structure of the game of chess itself (learning, at least on the order of Bateson's Level-2).

Perhaps this is an area to which personal computing may make a contribution, many of the current programs require surprisingly little in the way of hardware (a program running on a 4K mini came in second in the First USCCC). In this context Newborn's **Computer Chess** *is a fascinating history, a challenging example, and a reminder of our imperfect understanding of our own cognitive processes; for all their mystique and power, the number crunchers are still only wood shufflers.*

—Marc Le Brun



Computer Chess
Monroe Newborn
1975; 200pp.
$15.00 postpaid
from:
Academic Press
111 Fifth Avenue
New York, NY 10003
or Whole Earth

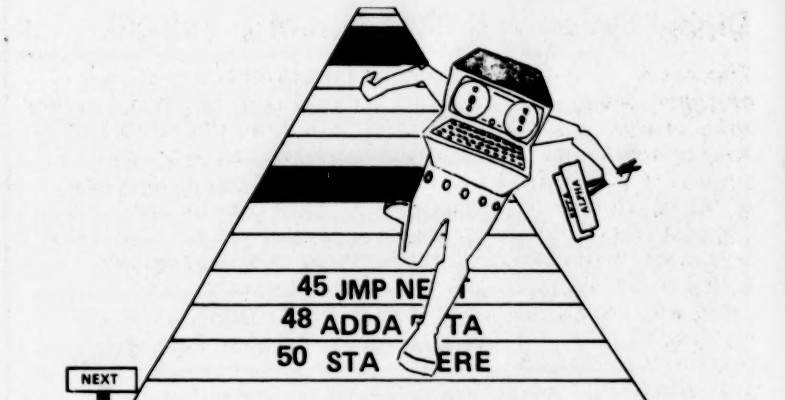
BYTE Magazine

A new glossy magazine devoted to personal computing, **BYTE** *– "the small systems journal," is, with its very first issue something of a phenomenon. Planning on a 24 page format and an initial press run of 1000 copies Publisher Wayne Green (of* **73 Magazine***) and Editor Carl Helmers (of* **ECS Journal***) found the response so great that this was expanded to 96 pages and 50,000 copies. The articles are useful and interesting to a broad range of computer hobbyists, with emphasis on hardware, software, applications, news and reviews. The first issue features eight articles, thirteen reviews (clubs, newsletters and books), nineteen advertisers, three letters (from charter subscribers) and an assortment of tips, gossip, editorials and random information. Professionally produced, written and edited,* **BYTE** *nevertheless has an appealing "homebrew" tone.*

–Marc Le Brun
[Suggested by Fred Moore]

[[It was Fred Moore, attentive readers will remember, who was given the $15,000 at the Demise Party celebrating the end of the Whole Earth Catalog]]

BYTE
(published monthly)
$1.50 /issue
$12.00 /year
from:
Green Publishing
Peterborough, NH 03458



The Forward Reference Problem

•

The Elements of Programming Style by Brian W. Kernighan and P. J. Plauger. McGraw-Hill, New York, 1974. $3.95.

This book is required reading for anyone who is seriously interested in writing good programs. Even the best programmers (and especially the most clever ones) can profit from reading this book. The authors take all their examples of dubious programming practices from textbooks intended to teach programming!

Hobbyist computer suppliers and clubs

The do-it-yourself hobbyist computer movement is expanding at a great rate. There are now lots of clubs for home built computer buggs, many companies selling computers and computer kits for prices in the $500 range, and at least one computer store (affiliated with the Atlanta club – see attached list) operated rather like a Hi Fi store.

SUPPLIERS

MITS
6328 Linn N.E.
Albuquerque, NM 87108

The people that started it all. In addition to the well known Altair 8800 (based on the Intel 8080) they now have the Altair 680 (based on the Motorla 6800). The 680 costs $345 in kit form, $420 assembled.

Southwest Technical Products
Box 32040
San Antonio, TX 78284

Have been in the business of selling Hi-Fi and test equipment kits. Their computer kit is the M6800 (based on the Motorola 6800). It costs $450.

IMS Associates, Inc.
1922 Republic Ave.
San Leandro, CA 94577

These people have the novel idea of hooking together a bunch (16 to 128) of 8080 microcomputers to make a machine with the number crunching power of a medium sized IBM machine. Nobody I know has seen these beasts in operation, but as a byproduct IMS is offering an 8080 based machine called the IMSAI 8080. The kit is $439; assembled it is $621.

MOS Technology, Inc.
950 Rittenhouse Rd.
Norristown, PA 19401

MOS Tech is a semiconductor manufacturer; they make the 6500 microprocessor. They recently introduced a fully assembled one card computer called the KIM-1. It costs $245, cheap. On the other hand, from the pictures I've seen it looks like a pretty sparse machine. I'm not sure that a power supply is included in the $245 price. The interesting thing is that a semiconductor manufacturer thinks the do-it-yourself market is attractive enough to enter. Hopefully other semiconductor houses will do the same, driving middlemen out and prices down.

Microcomputer Associates Inc.
111 Main St.
Los Altos, CA 94022

MAI sells a system called JOLT. It is based on MOS Tech's 6500 (see above). The basic system is a single card; assembled it is $348, as a kit $249.

Martin Research
3336 Commercial Ave.
Northbrook, IL 60062

Martin makes the MIKE 2 (based on the Intel 8008, an obsolete device) and the MIKE 3 (based on the Intel 8080). Both units come assembled, MIKE 2 for $345 and MIKE 3 for $495.

CLUBS

Homebrew Computer Club
c/o Robert Reiling
Box 626
Mountain View, CA 94042

Southern California Computing Society
c/o Hal Lashlee
Box 987
South Pasadena, CA 91030

Santa Barbara Nameless Computer Club
c/o Doug Penrod
1445 La Cima Road
Santa Barbara, CA 93101

Miami Area Computer Club
c/o Terry Wilson
P.O. Box 430852
S. Miamia, FL 33143

Atlanta Area Microcomputer Hobbyist Club
c/o Jim Dunion
Atlanta, GA 30307
404 - 373-8990

Chicago Computer Club
c/o Robert Schwarz
P.O. Box 66
Vernon Hills, IL

Bit Users Association
Resource Access Center
3010 4th Ave. S.
Minneapolis, MN 55408

Nashua Area Computer Club
c/o Dwayne Jeffries
181 Cypress Lane
Nashua, NH 03060

The Amateur Computer Club of New Jersey
c/o Sol Libes
201 - 889-2000

New York City Micro Hobbyist Group
c/o Robert Schwartz
375 Riverside Drive
Apt. 1E
New York, NY 10025

Pittsburgh Area Computer Club
400 Smithfield St.
Pittsburgh, PA 15222

The Computer Hobbyist Group of North Texas
c/o Bill Fuller
2377 Dalworth 157
Grand Prairie TX 75050

Digital Design with Standard MSI and LSI

Thomas R. Blakeslee's account of the current state of the art of digital design is useful to the designer and the almost-layman alike, as well as providing a thorough text on the subject of how to handle the new large and medium scale integrated circuits (LSI & MSI), he also presents a fascinating overview of the developments in digital technology over the past two decades, the discussion of the social impact of this technology says most of the things many computer people have been trying to articulate for years. This book is accessible to those who are not highly trained in either mathematics or electronics. If you know what a gate is and how to read a flowchart you will be able to handle almost all the material presented here. He covers everything from discrete logic components to one-chip microprocessors and high level languages for them. The emphasis is on minimization of IC packages and interconnections rather than logic gate minimization. Sections include "The Real Goals of Design," "The Black Box Concept," "The Program-Logic Tradeoff," "The Engineer as a Dope Pusher," . . .

– Shel Kaphan

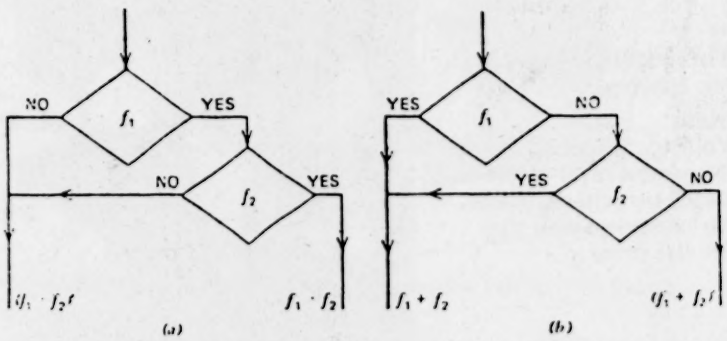
Digital Design with Standard MSI and LSI
Thomas R. Blakeslee
1975; 357pp.
$19.95 postpaid
from:
Wiley-Interscience
One Wiley Dr.
Somerset, NJ 08873
or Whole Earth

When a patient asks a doctor for a drug that is harmful, it is quite natural for the doctor to refuse since he can personally see the harmful effects on the patient if he does otherwise. The engineering profession, however, has no such face-to-face contact with its clients. *The engineer's client is the entire society*, rather than an individual. It therefore takes a much greater awareness on his part to see the ultimate results of his actions. The engineer can, in effect, produce heroin by the carload without ever looking into the addict's face.

•

If we consider the rate of development of integrated circuit technology between 1962 and 1972, it is easy to see why ICs have surpassed all other technologies so quickly. Although the technologies for making mechanical components have evolved only gradually, IC technology has had an explosive, exponential growth. The number of components that can be squeezed on a 100-mil^2 (0.01 X 0.01 in.) IC chip has doubled every 15 months during the 10-year period from 1962 to 1972. More important, this trend seems certain to continue for many more years! Combining this with the quadrupling of wafer size and doubling of chip size over the same period, we find that the *cost per component in ICs has decreased by a factor of 1000 in 10 years!*

•

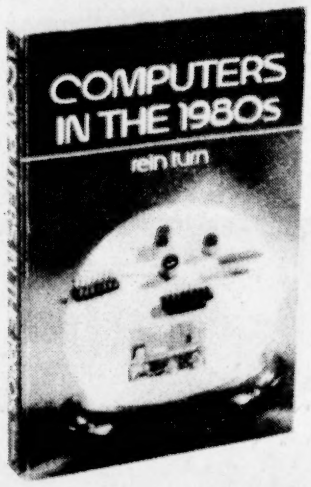


Flow chart Boolean structures: (a) AND structure; (b) OR structure.

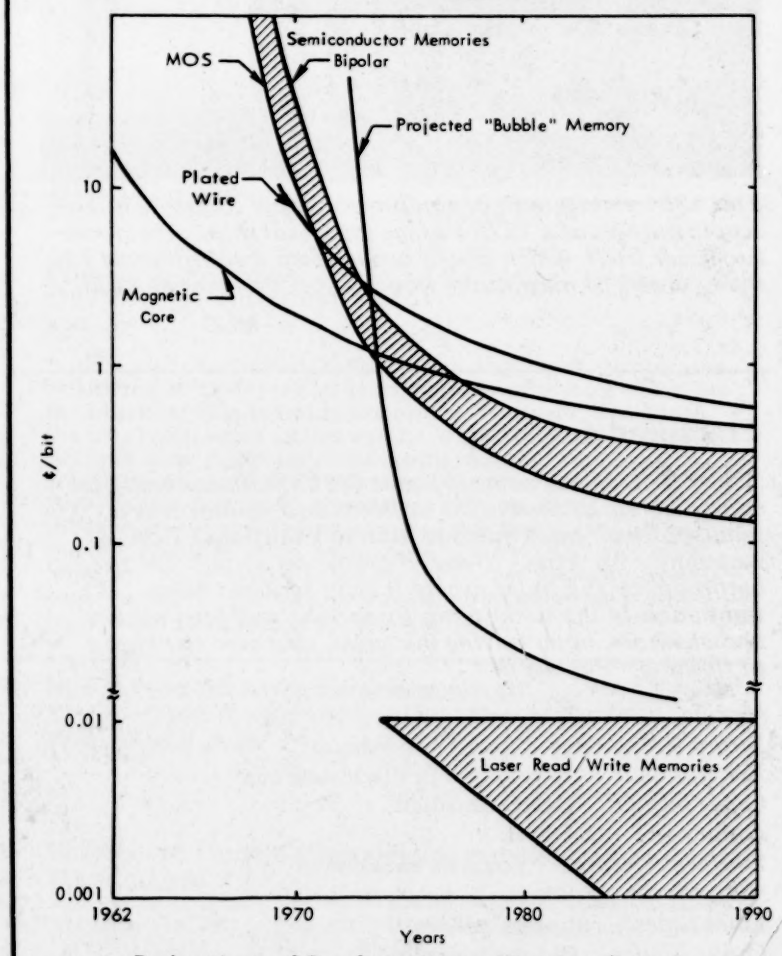
Computers in the 1980s

This book is a technological forecast by a senior systems analyst for The Rand Corporation and is based in part on a study conducted for the Air Force. It is clear, informative, dense and open ended. The author gives the reader some background in the methods of forecasting and the supporting analyses, in addition to the actual forecast, so that users of the forecast can check and revise it for themselves. Although it does not have a personal computing orientation (there is a bias toward very large and also rugged systems) the discussion of future trends in the system design and component technologies is both fascinating and relevant to anyone likely to be affected by computers in the next fifteen years.

– Marc LeBrun



Computers in the 1980s
Rein Turn
1974; 257pp.
$3.95 postpaid
from:
Columbia University Press
136 So. Broadway
Irvington-on-Hudson, NY 10533
or Whole Earth



Projections of Random-Access Memory Cost.

There is a direct equivalence between the structure of a flow chart and the Boolean logic functions. Figures 7-11a and b, for example, show AND and OR structures as they appear on a flow chart. As with gates, these structures can be combined to make any desired function. Notice that the functions f_1 and f_2 are generated *at separate times* using the *same processor logic*. *This is the key to the logic savings with programmed logic* and also why it is basically slower. Instead of generating f_1 and f_2 with two separate gates simultaneously, we use the same gates and "remember" the result with a conditional program branch.

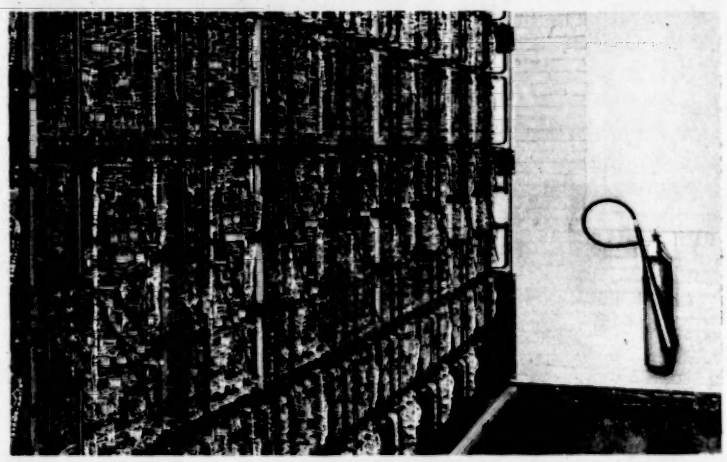
Computer structures

A natural history of computer architecture. Forty-four chapters present the inner structure of numerous systems in detail, often by reproducing the original description. The entire history (to 1970) is represented – from the Whirlwind I to the IBM 360, and a broad spectrum of sizes – from the Olivetti Programma 101 Desk Calculator to the ILLIAC IV. (Microcomputers are, of course, not represented). Although the technologies are somewhat dated, the structures themselves remain of more than passing interest in this age of do-it-yourself.

–Marc Le Brun

Computer Structures: Readings and Examples
C. Gordon Bell and
Allen Newell
1971; 668pp.
$19.50 postpaid

from:
McGraw-Hill Book Co.
Princeton Rd.
Hightstown, NJ 08520
or Whole Earth



This 1951-vintage wall of equipment would occupy a microscopic portion of a 1975-vintage processor chip. The microprocessor itself, which would outperform the Whirlwind I by many orders of magnitude, would fit on the head of a pin.

–MLB

Fractured anatomy

The W.B. Saunders company sent the CQ *office a beautiful color diagram of the human skeleton and ligaments as a sample of their book* **Introduction to Functional Human Anatomy: An Atlas**. *It was so pretty we posted it in the bathroom by the toilet, where it soon acquired some translation of the Latin terms by various staff and visitors, one of whom, upon leaving the toilet, said over the sound of flushing, "Publish it!"*

Maxilla Max is not well
Satura lambdoidea Ewe's sex manual
Epistropheus He urinated in my loving cup
Caput humeri Dead comedian
Caput radii Old tires
Lumbar vertebrae Logger's backbone
Ala ossis ilii Everyone is sick here
Linea aspera Straight snakes
Caput fibulae Old prevarication
Malleolus medialis Smelly badge
Phalanges digitorum pedis Let your fingers do the walking
Lig. acromioclaviculare Lig, the farmer, has apprehended my clavichord
Lig. iliofemorale Lig is sick of ladies
Lig. ischiofemorale Lig eschews ladies
Lig. meniscofemorale posterius Lig likes ladies with little bottoms
Capsula articularis Talking medicine
Capsula articularis Short article
Tendo calcaneus Offering of pet food

Peter Kagan and the Wind

Mostly **The CQ** *only tries to do reviews in areas where we know everything that's available, such as Soft Technology and Land Use. But when we come across something extraordinary we'll run it whether or not we comprehensively know its domain, such as records.*

"Peter Kagan and the Wind," by Gordon Bok, is the best piece of sung and told story-telling since Arlo Guthrie's "Alice's Restaurant." Peter Kagan is a New England fisherman with a dory and a seal for a wife. The story concerns one trip out in winter when the weather goes wrong, and Kagan must use every trick he knows to stay ahead of it. As the danger and exhaustion increase he begins to speak to his sail and to the wind, and they to him.

The wind says: I'll veer on you; I'll go east again.
Kagan says: You go ahead. Then I can hold my course again.
The wind says: I'll back.
Kagan says: You back too far and you'll have to clear. You know that. I can keep ahead of you.
Wind says: You may be smarter, but I'm stronger.

The story is nautically correct in detail, and there lies no small portion of its emotional power. Gordon Bok is in fact a Maine fisherman. He sings with skill and warmth, an adroit guitar, and authority.

–SB
[Suggested by Paul Winter]

Peter Kagan and the Wind
Gordon Bok
$6.95 postpaid
from:
Folk-Legacy Records
Sharon, CT 06069

The First Seven Days

When I first got this record by Jan Hammer I listened to it straight through four times. It is a highly inventive, never repetitive, blend of easy piano, light percussion, and virtuoso synthesizer. But it's not exotic. It's melodic, traces of classical, traces of jazz, and fills a room whole with excitement. I like Terry Riley ("In C," "Rainbow in Curved Air"), and Steve Reich ("Drumming"), and Miles Davis. I like this better.

–SB
[Suggested by Richard Baker]

The First Seven Days
Jan Hammer
from:
Your local record store
Suggested retail price is $4.95 but check prices.
No reason to pay the full list price.

Learning

Joni Mitchell

An interview with Joni Mitchell about her education was scheduled for this CQ, *but she wants to expand the piece, and so it will appear in the Summer '76* CQ.

Cricket

This magazine is needed. I taught freshman English in college for five years and most of my students lacked interest in and appreciation of good writing. I cannot prove a formal connection, but most of these students did not read and were not read to as children. Those who did read had the average middle-class dosage of Nancy Drew and her ilk, but very little of quality was read at home and of course school reading made no impression.

The quality and diversity of Cricket*'s articles and the excellence of its artwork will please children from pre-school to junior high and all discriminating adults. The editorial staff and board includes Clifton Fadiman, I.B. Singer, Kaye Webb and other lights of children's writing. The editors recognize that young people care about everything and so there are folk tales, animal stories, stories in translation, poetry, riddles (what children's magazine or what child can do without them?), puzzles, things to make, explanations of scientific facts, book reviews, reminiscences and articles about sports and sport figures. My children do not read yet, but they faithfully execute craft projects and the illustrations are springboards for stories they make up until mother or father has time to read to them. Older children have been known to read them from cover to cover, over and over (the library types); and others read only the articles that interest them but I have never heard of an issue of* Cricket *being thrown away.*

There is a healthy mix of the old favorites such as Ogden Nash, and Laura Ingalls Wilder with contemporaries like John Ciardi and Jane Yolen. In a regular feature called "Meet Your Author," a writer gets to talk to his/her audience about the craft of writing ("How Mary Poppins Found Me," by Kaye Webb). Children can learn that stories don't just appear but that they are written, crafted by real people with families, allergies, animal pets, and favorite things.

Cricket *does not talk down to young people. It is sensible, talks sense and knows what good nonsense is. The adults in* Cricket *stories are realistic. Parents yell and forget things important to children not from malice but because their lives are busy and full of responsibility. These children and adults tease, love, scold, laugh and learn from one another.*

If you have only ten dollars to spend on your children or some one else's children this year, invest your money in Cricket. *Neither you or the child will be disappointed.*

—Rose A. Doherty

Cricket
Clifton Fadiman, ed.
$10.00/yr.
from:
Cricket
P.O. Box 100
La Salle, IL 61301

Can you say "Richard and Robert had a rabbit" without saying the "r's"?
Sure. Dick and Bob had a bunny.

Melanie Orem, age 9
Russiaville, Indiana

Read For Your Life

My head is so full of the many lyrical studies of recent years about the impossibility of life and learning in public schools that I had a hard time reading Julia Reed Palmer's Read For Your Life *for what it says. The book is a not-very-stylish account ("first we did this, and then we did that, and next. . .") of a determined non-librarian's efforts to put a bookmobile on the streets of Brooklyn. . . and to make it really possible for children to use it. If that doesn't sound like such a big deal, then it's probably worth reading this book.*

The whole project. . . called "Buttercup" . . . was a curious amalgam of innocence, determination, plodding hard work, thoroughness and attention to every dumb detail. The amount of work it takes to make a modest-sounding project actually get off the ground is documented here in a way that has little drama or color in the retelling . . . but is nonetheless very compelling in its own way. Pick a thing to do that can be done. . . keep very close to your customers. . . work real hard. . . try not to make big mistakes. . . work real hard.

The book is most valuable for being (after a brief account of "Buttercup") largely a bibliography. . . a good one. . . 400 pages worth. . . arranged in several useful ways, including annotated lists of books of special interest to Blacks, Chicanos, Orientals, American Indians and Puerto Ricans. Palmer's notes include comments on which books her readers liked best.

—George Cope

Read for Your Life
Julia Reed Palmer
1974; 508pp.
$15.00 postpaid

from:
Scarecrow Press, Inc.
P.O. Box 656
Metuchen, NJ 08840
or Whole Earth

Famous Negro Athletes, by Arna Bontemps. Dodd, Mead, c1964. $3.50 (Apollo pb $1.95)

RL: 6 IL: 5-adult BSMP

It may seem redundant still to carry this book (which was published in 1964) when so many new ones now celebrate the black athlete individually and collectively, but I love the way Bontemps writes and he writes of some heroes who are now neglected. Joe Louis, Satchel Paige and Jesse Owens are almost unknown to a new generation. Even Jackie Robinson sometimes isn't recognized. Yet these men were trailblazers as was this book. It was on the bookmobile when we opened in July 1967 and very popular. Now most people pass it by for more up-to-date paperbacks. It has just been reissued in paperback which may renew its popularity. Photographs.

How do you get down from an elephant?
You don't get down from an elephant, you get down from a duck.

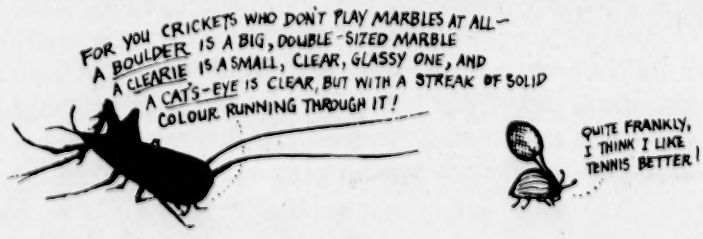
Richard Pizzo, age 7
Saddle Brook, New Jersey

What can go through the water and not get the least bit wet?
The sunshine.

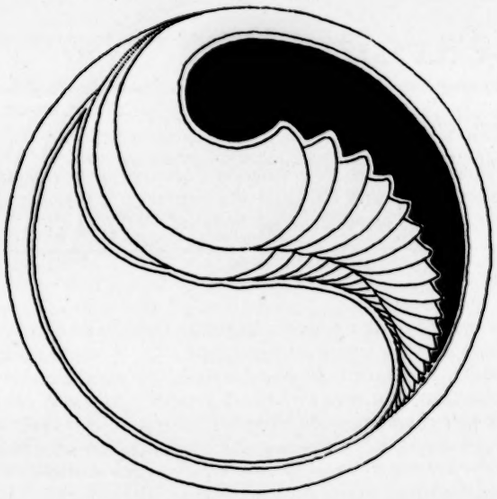
Kathy Snyder, age 9
Vicksburg, Michigan

What is gray, has big ears, a tail, and a trunk?
A mouse going on vacation.

James Fitzsimmons, age 8
Granby, Connecticut



TAKE AS DIRECTED



BY RON JONES

What follows is a true story.

It took place at Cubberly High School, Palo Alto, California, on five days in April, 1969 — the height of "do your own thing."

—SB

For years I kept a strange secret. I shared this silence with two hundred students. Yesterday I ran into one of those students. For a brief moment it all rushed back.

Steve Coniglo had been a sophomore student in my World History class. We ran into each other quite by accident. It's one of those occasions experienced by teachers when they least expect. You're walking down the street, eating at a secluded restaurant, or buying some underwear when all of a sudden an ex-student pops up to say hello. In this case it was Steve running down the street shouting, "Mr. Jones, Mr. Jones." In an embarrassed hug we greet. I had to stop for a minute to remember. Who is this young man hugging me? He calls me Mr. Jones. Must be a former student. What's his name? In the split second of my race back in time Steve sensed my questioning and backed up. Then smiled, and slowly raised a hand in a cupped position. My God. He's a member of the Third Wave. It's Steve, Steve Coniglo. He sat in the second row. He was a sensitive and bright student. Played guitar and enjoyed drama.

We just stood there exchanging smiles when without a conscious command I raised my hand in curved position. The salute was given. Two comrades had met long after the war. The Third Wave was still alive. "Mr. Jones do you remember the Third Wave?" I sure do, it was one of the most frightening events I ever experienced in the classroom. It was also the genesis of a secret that I and two hundred students would sadly share for the rest of our lives.

We talked and laughed about the Third Wave for the next few hours. Then it was time to part. It's strange, you meet a past student in these chance ways. You catch a few moments of your life. Hold them tight. Then say goodbye. Not knowing when and if you'd ever see each other again. Oh, you make promises to call each other but it won't happen. Steve will continue to grow and change. I will remain an ageless benchmark in his life. A presence that will not change. I am Mr. Jones. Steve turns and gives a quiet salute. Hand raised upward in a shape of a curling wave. Hand curved in a similar fashion I return the gesture.

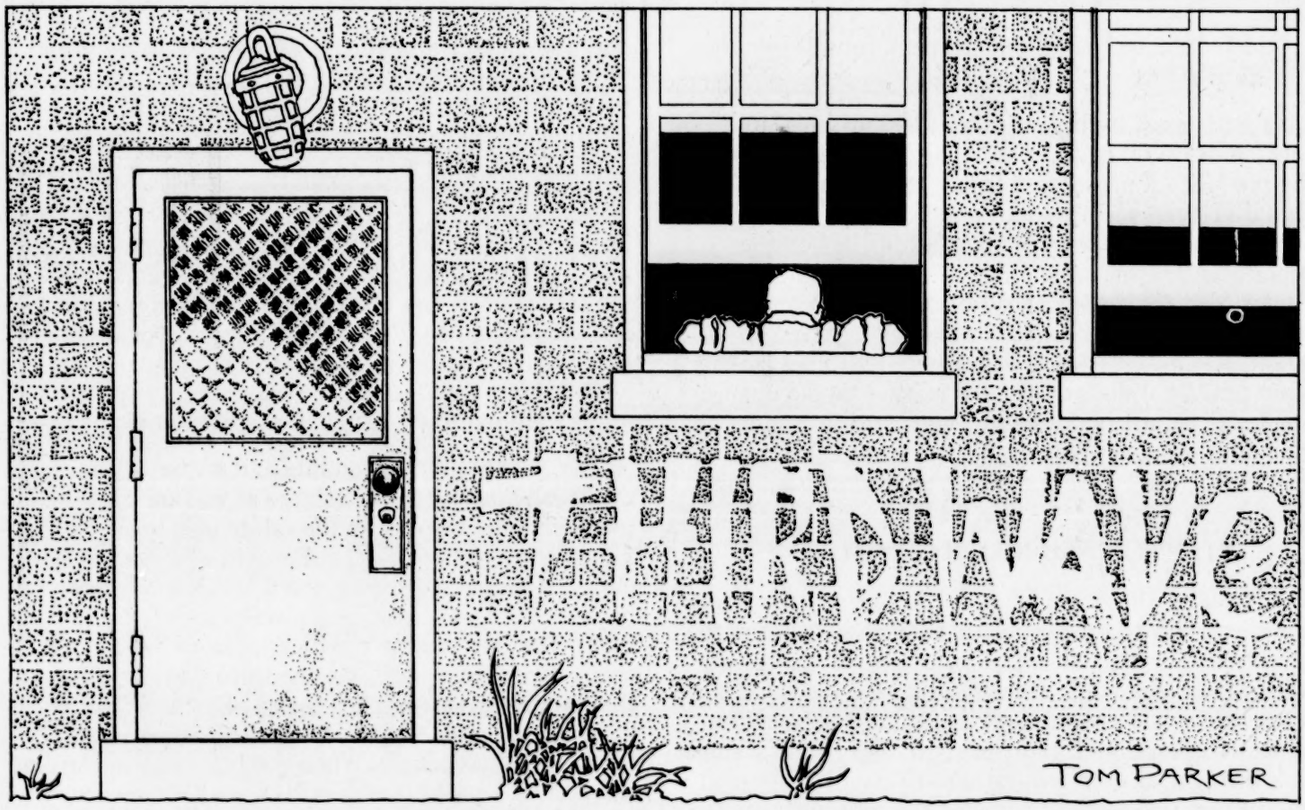
The Third Wave. Well at last it can be talked about. Here I've met a student and we've talked for hours about this nightmare. The secret must finally be waning. It's taken three years. I can tell you and anyone else about the Third Wave. It's now just a dream, something to remember, no it's something we tried to forget. That's how it all started. By strange coincidence I think it was Steve who started the Third Wave with a question.

We were studying Nazi Germany and in the middle of a lecture I was interrupted by the question. How could the German populace claim ignorance of the slaughter of the Jewish people. How could the townspeople, railroad conductors, teachers, doctors, claim they knew nothing about concentration camps and human carnage. How can people who were neighbors and maybe even friends of the Jewish citizen say they weren't there when it happened. It was a good question. I didn't know the answer.

In as much as there were several months still to go in the school year and I was already at World War II, I decided to take a week and explore the question.

STRENGTH THROUGH DISCIPLINE

On Monday, I introduced my sophomore history students to one of the experiences that characterized



Nazi Germany. Discipline. I lectured about the beauty of discipline. How an athlete feels having worked hard and regularly to be successful at a sport. How a ballet dancer or painter works hard to perfect a movement. The dedicated patience of a scientist in pursuit of an idea. It's discipline. That self training. Control. The power of the will. The exchange of physical hardships for superior mental and physical facilities. The ultimate triumph.

To experience the power of discipline, I invited, no I commanded the class to exercise and use a new seating posture. I described how proper sitting posture assists concentration and strengthens the will. In fact I instructed the class in a mandatory sitting posture. This posture started with feet flat on the floor, hands placed flat across the small of the back to force a straight alignment of the spine. "There, can't you breathe more easily? You're more alert. Don't you feel better?"

We practiced this new attention position over and over. I walked up and down the aisles of seated students pointing out small flaws, making improvements. Proper seating became the most important aspect of learning. I would dismiss the class, allowing them to leave their desks, and then call them abruptly back to an attention sitting position. In speed drills the class learned to move from standing position to attention sitting in fifteen seconds. In focus drills I concentrated attention on the feet being parallel and flat, ankles locked, knees bent at ninety degree angles, hands flat and crossed against the back, spine straight, chin down, head forward. We did noise drills in which talking was allowed only to be shown as a distraction. Following minutes of progressive drill assignments the class could move from standing positions outside the room to attention sitting positions at their desks without making a sound. The manuever took five seconds.

It was strange how quickly the students took to this uniform code of behavior. I began to wonder just how far they could be pushed. Was this display of obedience a momentary game we were all playing, or was it something else? Was the desire for discipline and uniformity a natural need? A societal instinct we hide within our franchise restaurants and T.V. programming?

I decided to push the tolerance of the class for regimented action. In the final twenty-five minutes of the class I introduced some new rules. Students must be sitting in class at the attention position before the late bell; all students must carry pencils and paper for note taking; when asking or answering questions a student must stand at the side of their desk; the first word given in answering or asking a question is "Mr. Jones." We practiced a short "silent reading" session. Students who responded in a sluggish manner were reprimanded and in every case made to repeat their behavior until it was a model of punctuality and respect. The intensity of the response became more important than the content. To accentuate this, I requested answers to be given in three words or less. Students were rewarded for making an effort at answering or asking questions. They were also acknowledged for doing this in a crisp and attentive manner.

Soon everyone in the class began popping up with answers and questions. The involvement level in the class moved from the few who always dominated discussions to the entire class. Even stranger was the gradual improvement in the quality of answers. Everyone seemed to be listening more intently. New people were speaking. Answers started to stretch out

as students usually hesitant to speak found support for their effort.

As for my part in this exercise, I had nothing but questions. Why hadn't I thought of this technique before? Students seemed intent on the assignment and displayed accurate recitation of facts and concepts. They even seemed to be asking better questions and treating each other with more compassion. How could this be? Here I was enacting an authoritarian learning environment and it seemed very productive. I now began to ponder not just how far this class could be pushed but how much I would change my basic beliefs toward an open classroom and self directed learning. Was all my belief in Carl Rogers to shrivel and die? Where was this experiment leading?

STRENGTH THROUGH COMMUNITY

On Tuesday, the second day of the exercise, I entered the classroom to find everyone sitting in silence at the attention position. Some of their faces were relaxed with smiles that come from pleasing the teacher. But most of the students looked straight ahead in earnest concentration. Neck muscles rigid. No sign of a smile or a thought or even a question. Every fibre strained to perform the deed. To release the tension I went to the chalk board and wrote in big letters "STRENGTH THROUGH DISCIPLINE." Below this I wrote a second law "STRENGTH THROUGH COMMUNITY."

While the class sat in stern silence I began to talk lecture sermonize about the value of community. At this stage of the game I was debating in my own mind whether to stop the experiment or continue. I hadn't planned such intensity or compliance. In fact I was surprised to find the ideas on discipline enacted at all. While debating whether to stop or go on with the experiment I talked on and on about community. I made up stories from my experiences as an athlete, coach and historian. It was easy. Community is that bond between individuals who work and struggle together. It's raising a barn with your neighbors, it's feeling that you are a part of something beyond yourself, a movement, a team, La Raza, a cause.

It was too late to step back. I now can appreciate why the astronomer turns relentlessly to the telescope. I was probing deeper and deeper into my own perceptions and the motivations for group and individual action. There was much more to see and try to understand. Many questions haunted me. Why did the students accept the authority I was imposing? Where is their curiosity or resistance to this martial behavior? When and how will this end?

Following my description of community I once again told the class that community like discipline must be experienced if it is to be understood. To provide an encounter with community I had the class recite in unison, "Strength Through Discipline." "Strength Through Community." First I would have two students stand and call back our motto. Then add two more until finally the whole class was standing and reciting. It was fun. The students began to look at each other and sense the power of belonging. Everyone was capable and equal. They were doing something together. We worked on this simple act for the entire class period. We would repeat the mottos in a rotating chorus, or say them with various degrees of loudness. Always we said them together, emphasizing the proper way to sit, stand, and talk.

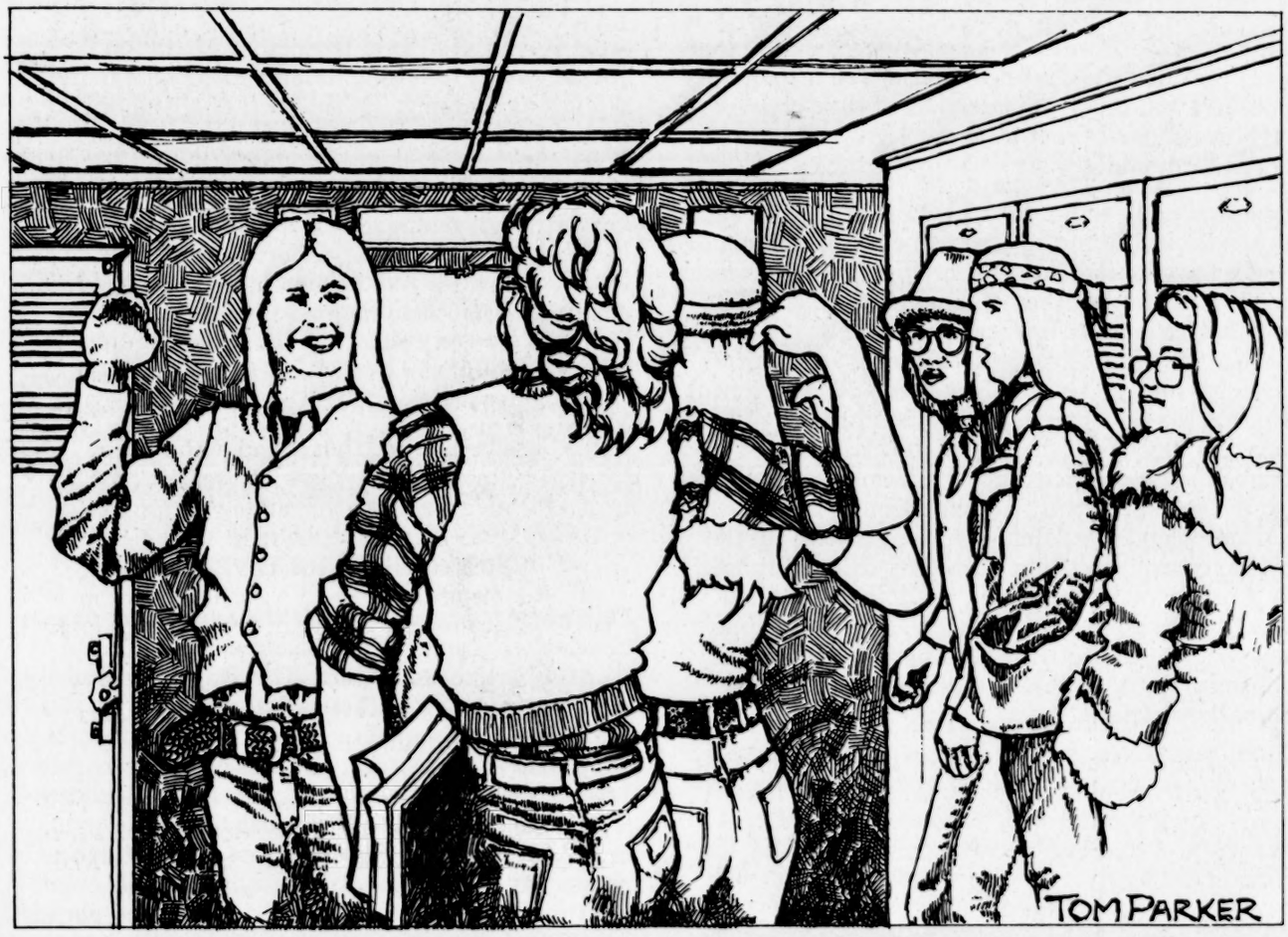
I began to think of myself as a part of the experiment. I enjoyed the unified action demonstrated by the students. It was rewarding to see their satisfaction and excitement to do more. I found it harder and harder to extract myself from the momentum and identity that the class was developing. I was following the group dictate as much as I was directing it.

As the class period was ending and without forethought I created a class salute. It was for class members only. To make the salute you brought your right hand up toward the right shoulder in a curled position. I called it the Third Wave salute because the hand resembled a wave about to top over. The idea for the three came from beach lore that waves travel in chains, the third wave being the last and largest of each series. Since we had a salute I made it a rule to salute all class members outside the classroom. When the bell sounded ending the period, I asked the class for complete silence. With everyone sitting at attention I slowly raised my arm and with a cupped hand I saluted. It was a silent signal of recognition. They were something special. Without command the entire group of students returned the salute.

Throughout the next few days students in the class would exchange this greeting. You would be walking down the hall when all of a sudden three classmates would turn your way each flashing a quick salute. In the library or in gym students would be seen giving this strange hand jive. You would hear a crash of cafeteria food only to have it followed by two classmates saluting each other. The mystique of thirty individuals doing this strange gyration soon brought more attention to the class and its experiment into the German personality. Many students outside the class asked if they could join.

STRENGTH THROUGH ACTION

On Wednesday, I decided to issue membership cards to every student that wanted to continue what I now called The Experiment. Not a single student elected to leave the room. In this the third day of activity there were forty-three students in the class. Thirteen students had cut other classes to be a part of The Experiment. While the class sat at attention I gave each person a card. I marked three of the cards with a red X and informed the recipients that they had a special assignment to report any students not complying with class rules. I then proceeded to talk about the meaning of action. I explained how discipline and community were meaningless without action. I discussed the beauty of taking full responsibility for one's action. Of believing so thoroughly in yourself and your community or family that you will do anything to preserve, protect and extend that being. I stressed how hard work and allegiance



to each other would allow accelerated learning and accomplishment. I reminded students of what it felt like being in classes where competition caused pain and degradation. Situations in which students were pitted against each other in everything from gym to reading. The feeling of never acting, never being a part of something, never supporting each other.

At this point students stood without prompting and began to give what amounted to testimonials. "Mr. Jones, for the first time I'm learning lots of things." "Mr. Jones, why don't you teach like this all the time." I was shocked! Yes, I had been pushing information at them in an extremely controlled setting but the fact that they found it comfortable and acceptable was startling. It was equally disconcerting to realize that complex and time-consuming written homework assignments on German life were being completed and even enlarged on by students. Performance in academic skill areas was significantly improving. They were learning more. And they seemed to want more. I began to think that the students might do anything I assigned. I decided to find out.

To allow students the experience of direct action I gave each individual a specific verbal assignment. "It's your task to design a Third Wave Banner. You are responsible for stopping any student that is not a Third Wave member from entering this room. I want you to remember and be able to recite by tomorrow the name and address of every Third Wave Member. You are assigned the problem of training and convincing at least twenty children in the adjacent elementary school that our sitting posture is necessary for better learning. It's your job to read this pamphlet and report its entire content to the class before the period ends. I want each of you to give me the name and address of one reliable friend that you think might want to join the Third Wave." . . .

To conclude the session on direct action, I instructed students in a simple procedure for initiating new members. It went like this. A new member had only to be recommended by an existing member and issued a card by me. Upon receiving this card the new member had to demonstrate knowledge of our rules and pledge obedience to them. My announcement unleashed a fervor.

The school was alive with conjecture and curiosity. It affected everyone. The school cook asked what a Third Wave cookie looked like. I said chocolate chip of course. Our principal came into an afternoon faculty meeting and gave me the Third Wave salute. I saluted back. The librarian thanked me for our 30' banner on learning which she placed above the library entrance. By the end of the day over two hundred students were admitted into the order. I felt very alone and a little scared.

Most of my fear emanated from the incidence of tattletaling. Although I formally appointed only three students to report deviate behavior, approximately twenty students came to me with reports about how Allan didn't salute, or Georgene was talking critically

about our experiment. This incidence of monitoring meant that half the class now considered it their duty to observe and report on members of their class. Within this avalanche of reporting one legitimate conspiracy did seem under way.

Three women in the class had told their parents all about our classroom activities. These three young women were by far the most intelligent students in the class. As friends they chummed together. They possessed a silent confidence and took pleasure in a school setting that gave them academic and leadership opportunity. During the days of the experiment I was curious how they would respond to the egalitarian and physical reshaping of the class. The rewards they were accustomed to winning just didn't exist in the experiment. The intellectual skills of questioning and reasoning were nonexistent. In the martial atmosphere of the class they seemed stunned and pensive. Now that I look back, they appeared much like the child with so-called learning disability. They watched the activities and participated in a mechanical fashion. Where others jumped in, they held back, watching.

In telling their parents of the experiment they set up a brief chain of events. The rabbi for one of the parents called me at home. He was polite and condescending. I told him we were merely studying the German personality. He seemed delighted and told me not to worry. He would talk to the parents and calm their concern. In concluding this conversation I envisioned similar conversations throughout history in which the clergy accepted and apologized for untenable conditions. If only he would have raged in anger or simply investigated the situation I could point the students to an example of righteous rebellion. But no. The rabbi became a part of the experiment. In remaining ignorant of the oppression in the experiment he became an accomplice and advocate.

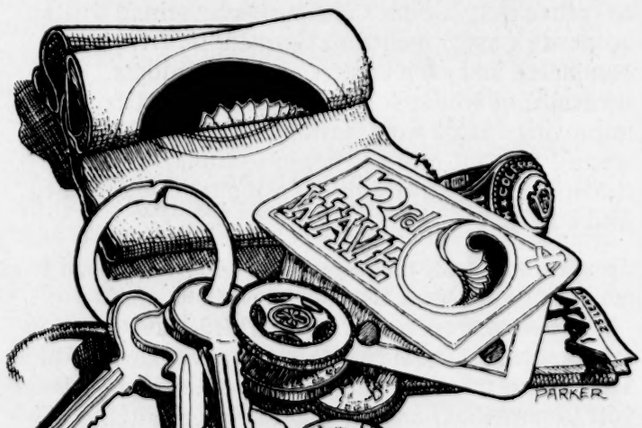
By the end of the third day I was exhausted. I was tearing apart. The balance between role playing and directed behavior became indistinguishable. Many of the students were completely into being Third Wave members. They demanded strict obedience of the rules from other students and bullied those that took the experiment lightly. Others simply sank into the activity and took self-assigned roles. I particularly remember Robert. Robert was big for his age and displayed very few academic skills. Oh he tried harder than anyone I know to be successful. He handed in elaborate weekly reports copied word for word from the reference books in the library. Robert is like so many kids in school that don't excel or cause trouble. They aren't bright, they can't make the athletic teams, and don't strike out for attention. They are lost, invisible. The only reason I came to know Robert at all is that I found him eating lunch in my classroom. He always ate lunch alone.

Well the Third Wave gave Robert a place in school. At least he was equal to everyone. He could do something. Take part. Be meaningful. That's just what Robert did. Late Wednesday afternoon I found Robert following me and asked what in the world was he doing. He smiled (I don't think I had ever seen him smile) and announced, "Mr. Jones, I'm your bodyguard. I'm afraid something will happen to you. Can I do it Mr. Jones, please?" Given that assurance and smile I couldn't say no. I had a bodyguard. All day long he opened and closed doors for me. He walked always on my right. Just smiling and saluting other class members. He followed me everywhere. In the faculty room (closed to students) he stood at silent attention while I gulped some coffee. When accosted by an English teacher for being a student in the "teacher's room" he just smiled and informed the faculty member that he wasn't a student, he was a bodyguard.

STRENGTH THROUGH PRIDE

On Thursday I began to draw the experiment to a conclusion. I was exhausted and worried. Many students were over the line. The Third Wave had become the center of their existence. I was in pretty bad shape myself. I was now acting instinctively as a dictator. Oh I was benevolent. And I daily argued to myself on the benefits of the learning experience. By this the fourth day of the experiment I was beginning to lose my own arguments. As I spent more time playing the role I had less time to remember its rational origins and purpose. I found myself sliding into the role even when it wasn't necessary. I wondered if this doesn't happen to lots of people. We get or take an ascribed role and then bend our life to fit the image. Soon the image is the only identity people will accept. So we became the image. The trouble with the situation and role I had created was that I didn't have time to think where it was leading. Events were crushing in around me. I worried for students doing things they would regret. I worried for myself.

Once again I faced the thoughts of closing the experiment or letting it go its own course. Both options were unworkable. If I stopped the experiment a great number of students would be left



hanging. They had committed themselves in front of their peers to radical behavior. Emotionally and psychologically they had exposed themselves. If I suddenly jolted them back to classroom reality I would face a confused student body for the remainder of the year. It would be too painful and demeaning for Robert and the students like him to be twisted back into their seat and told it's just a game. They would take ridicule from the brighter students that participated in a measured and cautious way. I couldn't let the Roberts lose again.

The other option of just letting the experiment run its course was also out of the question. Things were already out of control. Wednesday evening someone had broken into the room and ransacked the place. I later found out it was the father of one of the students. He was a retired Air Force colonel who had spent time in a German prisoner of war camp. Upon hearing of our activity he simply lost control. Late in the evening he broke into the room and tore it apart. I found him that morning propped up against the classroom door. He told me about his friends that had been killed in Germany. He was holding on to me and shaking. In staccato words he pleaded that I understand and help him get home. I called his wife and with the help of a neighbor walked him home. We spent hours later talking about what he felt and did, but from that moment on Thursday morning I was more concerned with what might be happening at school.

I was increasingly worried about how our activity was affecting the faculty and other students in the school. The Third Wave was disrupting normal learning. Students were cutting class to participate, and the school counselors were beginning to question every student in the class. The real gestapo in the school was at work. Faced with The Experiment exploding in one hundred directions, I decided to try an old basketball strategy. When you're playing against all the odds the best action to take is to try the unexpected. That's what I did.

By Thursday the class had swollen in size to over eighty students. The only thing that allowed them all to fit was the enforced discipline of sitting in silence at attention. A strange calm is in effect when a room full of people sit in quiet observation and anticipation. It helped me approach them in a deliberate way. I talked about pride. "Pride is more than banners or salutes. Pride is something no one can take from you. Pride is knowing you are the best . . . It can't be destroyed. . ."

In the midst of this crescendo I abruptly changed and lowered my voice to announce the real reason for the Third Wave. In slow methodic tone I explained what was behind the Third Wave. "The Third Wave isn't just an experiment or classroom activity. It's far more important than that. The Third Wave is a nationwide program to find students who are willing to fight for political change in this country. That's right. This activity we have been doing has been practice for the real thing. Across the country teachers like myself have been recruiting and training a youth brigade capable of showing the nation a better society through discipline, community, pride, and action. If we can change the way that school is run, we can change the way that factories, stores, universities and all the other institutions are run. You are a selected group of young people chosen to help in this cause. If you will stand up and display what you have learned in the past four days . . . we can change the destiny of this nation. We can bring it a new sense of order, community, pride and action. A new purpose. Everything rests with you and your willingness to take a stand."

To give validity to the seriousness of my words I turned to the three women in the class whom I knew had questioned the Third Wave. I demanded that they leave the room. I explained why I acted and then assigned four guards to escort the women to the library and to prevent them from entering the class on Friday. Then in dramatic style I informed the class of a special noon rally to take place on Friday. This would be a rally for Third Wave members only.

It was a wild gamble. I just kept talking, afraid that if I stopped someone would laugh or ask a question, and the grand scheme would dissolve in chaos. I explained how at noon on Friday a national candidate for President would announce the formation of a Third Wave Youth Program. Simultaneous to this announcement over 1000 youth groups from every part of the country would stand up and display their support for such a movement. I confided that they were the students selected to represent their area. I also questioned if they could make a good showing, because the press had been invited to record the event. No one laughed. There was not a murmur of resistance. Quite the contrary. A fever pitch of excitement swelled across the room. "We can do it!" "Should we wear white shirts?" "Can we bring friends?" "Mr. Jones, have you seen this advertisement in Time magazine?"

The clincher came quite by accident. It was a full page color advertisement in the current issue of Time for some lumber products. The advertiser identified his product as the Third Wave. The advertisement proclaimed in big red, white and blue letters, "The Third Wave is coming." "Is this part of the campaign, Mr. Jones? Is it a code or something?" "Yes. Now listen carefully. It's all set for tomorrow. Be in the small auditorium ten minutes before 12:00. Be seated. Be ready to display the discipline, community, and pride you have learned. Don't talk to anyone about this. This rally is for members only."

STRENGTH THROUGH UNDERSTANDING

On Friday, the final day of the exercise, I spent the early morning preparing the auditorium for the rally. At 11:30 students began to ant their way into the room, first a few scouting the way and then more. Row after row began to fill. A hushed silence shrouded the room. Third Wave banners hung like clouds over the assembly. At twelve o'clock sharp

I closed the room and placed guards at each door. Several friends of mine posing as reporters and photographers began to interact with the crowd taking pictures and jotting frantic descriptive notes. A group photograph was taken. Over two hundred students were crammed into the room. Not a vacant seat could be found. The group seemed to be composed of students from many persuasions. There were the athletes, the social prominents, the student leaders, the loners, the group of kids that always left school early, the bikers, the pseudo hip, a few representatives of the school's dadaist clique, and some of the students that hung out at the laundromat. The entire collection however looked like one force as they sat in perfect attention. Every person focusing on the TV set I had in the front of the room. No one moved. The room was empty of sound. It was like we were all witness to a birth. The tension and anticipation was beyond belief.

"Before turning on the national press conference, which begins in five minutes, I want to demonstrate to the press the extent of our training." With that I gave the salute, followed automatically by two hundred arms stabbing a reply. I then said the words "Strength Through Discipline," followed by a repetitive chorus. We did this again, and again. Each time the response was louder. The photographers were circling the ritual snapping pictures, but by now they were ignored. I reiterated the importance of this event and asked once more for a show of allegiance. It was the last time I would ask anyone to recite. The room rocked with a guttural cry, "STRENGTH THROUGH DISCIPLINE!"

It was 12:05. I turned off the lights in the room and walked quickly to the television set. The air in the room seemed to be drying up. It felt hard to breathe and even harder to talk. It was as if the climax of shouting souls had pushed everything out of the room. I switched the television set on. I was now standing next to the television directly facing the room full of people. The machine came to life producing a luminous field of pale blue light. Robert was at my side. I whispered to him to watch closely and pay attention to the next few minutes. The only light in the room was coming from the television and it played against the faces in the room. Eyes strained and pulled at the light but the pattern didn't change. The room stayed deadly still. Waiting. There was a mental tug of war between the people in the room and the television. The television won. The glow of the test pattern didn't snap into the vision of a political candidate. It just whined on. Still the viewers persisted. There must be a program. It must be coming on. Where is it? The trance with the television continued for what seemed like hours. It was 12:07. Nothing. A blank screen. It's not going to happen. Anticipation turned to anxiety and then to frustration. Someone stood up and shouted.

"There isn't any leader is there?" Everyone turned in shock, first to the despondent student and then back to the television. Their faces held looks of disbelief. In the confusion of the moment I moved slowly toward the television. I turned it off. I felt air rush back into the room. The room remained in fixed silence, but for the first time I could sense people breathing. Students were withdrawing their arms from behind their chairs. I expected a flood of questions, but instead got intense quietness. I began to talk. Every word seemed to be taken and absorbed.

"Listen closely, I have something important to tell you. There is no leader! There is no such thing as a national youth movement called the Third Wave. You have been used. Manipulated. Shoved by your own desires into the place you now find yourself. You are no better or worse than the German Nazi we have been studying.

"You thought that you were the elect. That you were better than those outside this room. You bargained your freedom for the comfort of discipline and superiority. You chose to accept the group's will and the big lie over your own conviction. Oh, you think to yourself that you were just going along for the fun. That you could extricate yourself at any moment. But where were you heading? How far would you have gone? Let me show you your future."

With that I switched on a rear screen movie projector. It quickly illuminated a white drop cloth hanging behind the television. Large numbers appeared in a countdown. The roar of the Nuremburg Rally blasted into vision. My heart was pounding. In ghostly images the history of the Third Reich paraded into the room. The discipline. The march of super race. The big lie. Arrogance, violence, terror. People being pushed into vans. The visual stench of death camps. Faces without eyes. The trials. The plea of ignorance. I was only doing my job. My job. As abruptly as it started the film froze to a halt on a single written frame. "Everyone must accept the blame – No one can claim that they didn't in some way take part."

The room stayed dark as the final footage of film flapped against the projector. I felt sick to my stomach. The room smelt like a locker room. No one moved. It was as if everyone wanted to dissect the moment, figure out what had happened. Like awakening from a dream and deep sleep, the entire room of people took one last look back into their consciousness. I waited for several minutes to let everyone catch up. Finally questions began to emerge. All of the questions probed at imaginary situations and sought to discover the meaning of this event.

In the still darkened room I began the explanation. I confessed my feeling of sickness and remorse. I told the assembly that a full explanation would take quite a while. But to start, I sensed myself moving from an introspective participant in the event toward the role of teacher. It's easier being a teacher. In objective terms I began to describe the past events.

"Through the experience of the past week we have all tasted what it was like to live and act in Nazi Germany. We learned what it felt like to create a disci-

plined social environment. To build a special society. Pledge allegiance to that society. Replace reason with rules. Yes, we would all have made good Germans. We would have put on the uniform. Turned our head as friends and neighbors were cursed and then persecuted. Pulled the locks shut. Worked in the "defense" plants. Burned ideas. Yes, we know in a small way what it feels like to find a hero. To grab quick solutions. Feel strong and in control of destiny. We know the fear of being left out. The pleasure of doing something right and being rewarded. To be number one. To be right. We have seen and perhaps felt what these actions taken to an extreme will lead to. We each have witnessed something over the past week. We have seen that fascism is not just something those other people did. No, it's right here. In this room. In our own personal habits and way of life. Scratch the surface and it appears. Something in all of us. We carry it like a disease. The belief that human beings are basically evil and therefore unable to act well toward each other. A belief that demands a strong leader and discipline to preserve social order. And there is something else. The act of apology.

"This is the final lesson to be experienced. This last lesson is perhaps the one of greatest importance. This lesson was the question that started our plunge in studying Nazi life. Do you remember the question? It concerned a bewilderment at the German populace claiming ignorance and non-involvement in the Nazi movement. If I remember the question, it went something like this. How could the German soldier, teacher, railroad conductor, nurse, tax collector, the average citizen, claim at the end of the Third Reich that they knew nothing of what was going on? How can a people be a part of something and then claim at the demise that they were not really involved? What causes people to blank out their own history? In the next few minutes and perhaps years, you will have an opportunity to answer this question.

"If our enactment of the Fascist mentality is complete, not one of you will ever admit to being at this final Third Wave rally. Like the Germans, you will have trouble admitting to yourself that you came this far. You will not allow your friends and parents to know that you were willing to give up individual freedom and power for the dictates of order and unseen leaders. You can't admit to being manipulated. Being a follower. To accepting the Third Wave as a way of life. You won't admit to participating in this madness. You will keep this day and this rally a secret. It's a secret I shall share with you."

I took the film from the three cameras in the room and pulled the celluloid into the exposing light. The deed was concluded. The trial was over. The Third Wave had ended.

I glanced over my shoulder. Robert was crying. Students slowly rose from their chairs and without words filed into the outdoor light. I walked over to Robert and threw my arms around him. Robert was sobbing, taking in large uncontrollable gulps of air. "It's over." "It's all right." In our consoling each other we became a rock in the stream of exiting students. Some swirled back to momentarily hold Robert and I. Others cried openly and then brushed away tears to carry on. Human beings circling and holding each other. Moving toward the door and the world outside.

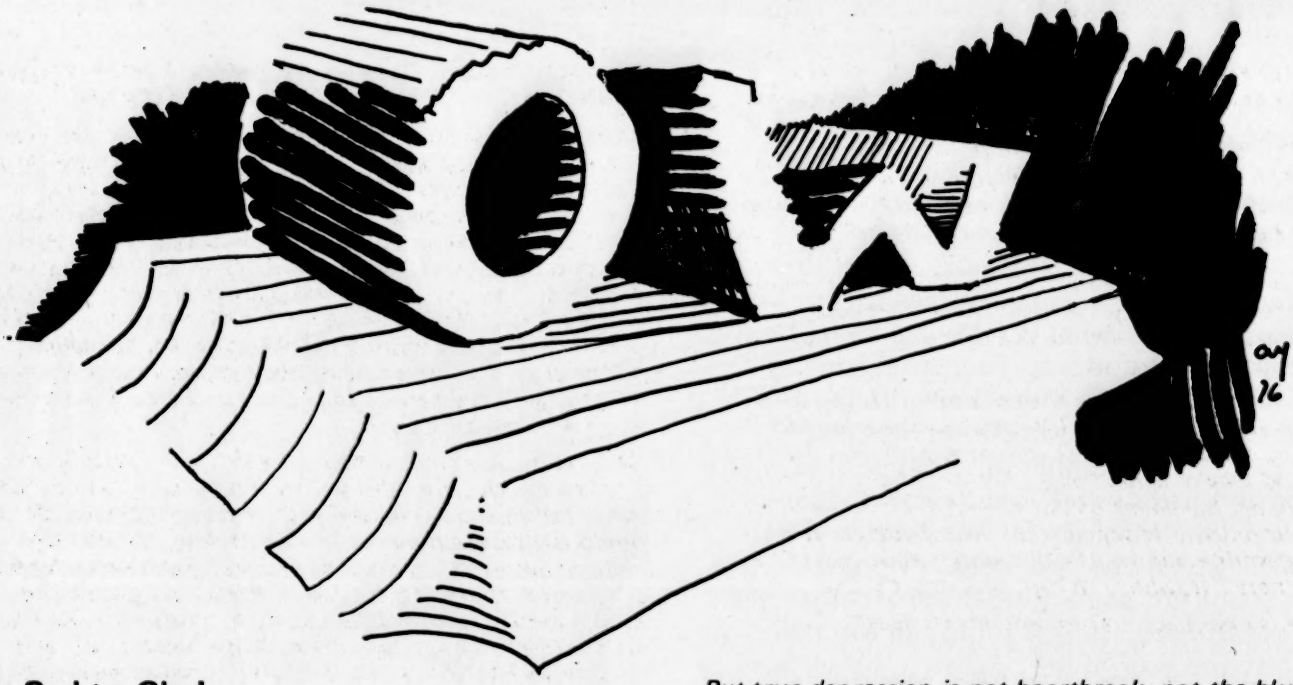
TOM PARKER

For a week in the middle of a school year we had shared fully in life. And as predicted we also shared a deep secret. In the four years I taught at Cubberley High School no one ever admitted to attending the Third Wave Rally. Oh, we talked and studied our actions intently. But the Rally itself. No. It was something we all wanted to forget. ■

Ron Jones now lives in San Francisco, is a member of The Briarpatch Network, and publishes and edits the excellent Deschool Primer series of workbooks (EPILOG, p. 722) available from Zephyrus, 1201 Stanyan St., San Francisco, CA 94117.

If you want to remark on the Third Wave, write to us at **The CQ**, *Box 428, Sausalito, CA 94965.*

—SB



G. Russ Youngreen

From Sad to Glad

You've heard things like this said before: this book may save your life. More important (because dead men do not feel), it may save you months and years of dreadful and irrelevant suffering.

This book is of potential interest to many people — to the colleagues, lovers, friends, and relations of depressives; to psychiatrists, doctors, social workers; to the curious. It's unique and unprecedented, a discussion of what is known of this malady written by a man who is, by experience, scholarship, and gifted observation, reassuringly qualified to write such a book. (There are bewilderingly few other books on depression. I can't be certain that I've seen them all, but the others I have seen are either idiosyncratic and wrong or stupid and wrong.)

I went through six shrinks and a couple ordinary doctors before I began to get even a whiff of what was wrong with me, and I'm a classic, regulation manic-depressive if ever there was one. Thousands and thousands of hours I suffered, because they didn't know and thought they did.

So the word is not out, and it needs to be. [It might, of course, be argued that all those depressive and manic-depressive suicides are not compounding the population problem, but it also seems to be true that manic-depressives are, remarkably often, extraordinary people (yes, of course I like to think that thought). Mogens Schou, one of the pioneers in the biz, has three Nobelers on lithium right now, though he's telling no names.]

Kline covers a lot: the history of depression as a medical entity; famous depressives (Darwin, Abe Lincoln, etc., etc.,); the best current theories as to the nature of the "biochemical storms," as he calls them, which are depression; manic-depressive illness; forms of treatment (including shock treatment, which, a stomachful of ignorant badmouthing to the contrary, may be profoundly beneficial in depression). The book is conversational, almost simple; but it's thorough and informative. (If, after reading it, you want more detail and sophistication, you now have a good basic knowledge with which to approach the Archives of General Psychiatry.*)*

But I'm really here to say that this book is, urgently, for depressives themselves. Buy it, beg it, borrow it, check it out: get it. Most doctors and most psychiatrists are not qualified to treat depression because they don't know anything true about it. They think it's something else. So you better know. Get this book.

But how can you know that what you've got is "true" depression? This is an insidious affliction because, at least when it's new to you, it looks like something else (often the same something else the professionals think it is.) From a lifetime of reasonable habit, we ascribe our bad feeling to whatever is wrong in our lives, and there's always something wrong in everybody's life. Lost love, lost job, too much dope, too little money, convictions of inferiority, a bad haircut.

But true depression is not heartbreak, not the blues; neither loss nor neurosis. After a loss or an injury to the heart there is a normal recovery pattern — the hurt subsides, over time, and the wound slips out of the present to go live gently in the past.

The pain of depression does not recede like that. It hangs around and suffocates like an August night in Georgia, unmoving for months — maybe years. For depression there is no comfort. There's just pain, which gallons of tenderness and beauty and reassurance cannot diminish. It's characteristically worst in the morning, subdued at night — and worse again the next morning. It will stay as long as it wants to stay, and no application of love or occupational therapy or changes of scene will move it before its time; and then it will go, when it wants to go. And when it's gone, it's gone, leaving no more tangible trace than the pain of a childhood injury. Nobody knows — yet — why it comes. Nobody knows why it goes.

But it will almost certainly come back. It's a game your brain plays inside itself.

The heart of the experience that is depression, the universal symptom, is the absence of all pleasure. From the fragile prettiness of a spiderweb to the melting savor of a truly great steak to the corruscating delights of lovemaking: all pleasures vanish. If you won the Nobel prize, the wine country of France, the loving esteem of all humankind, a Mazeratti, and another Nobel prize, all on the same balmy, sundrenched summer morning, you'd feel. . . perhaps fear, perhaps bewilderment, perhaps horror. But no pleasure. Depression is to the sensor of pleasure as blindness is to the eye.

If yours is a mild depression, it may be no more than the simple absence of pleasure. The world goes flat, & nothing calls to you. Whatever you loved, you don't love it anymore. You don't want to go running through meadows, dancing, bodysurfing, backpacking. You feel awkward around people, inferior because you have no spark to give them, no life. If you used to be witty, you aren't. Nothing is funny. Challenges become burdensome, unpleasant chores loom like dead Sequoias. You feel always either saggingly bored or hardpressed. Sex is without attraction, like the prospect of dining on birdseed. You initiate nothing, not adventures, not conversations.

But that's not so bad. When depression gets down to business, it adds to this bleakness a pervasive quality of dismay, which may darken to despair and horror. The world is black, from the deepest coils of your gut to the farthest star, and this hot blackness lies upon the faces of your friends, your children, and Robert Redford on the movie screen. It smears the pots in your kitchen and pelts out the water from your showerhead. You live like a drowning fish in an ocean of meaninglessness. Emptiness assaults you like all the armies that ever breathed the heat of battle.

Unaccountably, it seems desperately important that you appear to other people as if nothing were wrong. Your

polite smile is like wet clay stuck to your face, for you are inwardly paralyzed with dread and for you there is no such thing as play or even casual civility. Every gesture and every word must be forged, manufactured with as much difficulty and more concentration than goes into an entire chevrolet. Any decision, whether to leave your door open or closed, to have salad with dinner, to put a book back on the shelf, to take a coat — is agony, irresolvable. There is no criterion on which to base a decision, for all the feelings and preferences of ordinary life have been usurped by dread, and dread cannot tell you whether you want to wear green socks or blue ones.

This despair may bring along a friend, terror, known in the trade as "anxiety." It is a fear like acid, permeating the black ocean as the black ocean permeates your life, fear of nothing and fear of everything. Terror shrieks around you, recoiling off the edges of the universe, off your front door, off your pillow. It screams up out of gutters and boils out of gasoline pumps. Fear through your head like bullets, but there's nowhere to run, because it's there, too.

Except there is one place to run, and that's death. Some people do.

It's like nothing else, depression. It's horrible. But the right medication may dissolve the horror, and restore you to forests, and giggling, hot pastrami, Bach, moral outrage, sleeping late, and even falling in love.

Now. About doctors. (My solitary disappointment with Kline is that he doesn't give the hard information necessary for somebody who's depressed to find a doctor who will be useful to him.) The primary treatment of biochemical depression is, not surprisingly, chemical. Psychotherapy, as Kline points out, is not useful because it's not effective, unless you happen to be also neurotic or otherwise in need of psychotherapy. Depression itself is no more an appropriate target for psychotherapy than is diabetes.

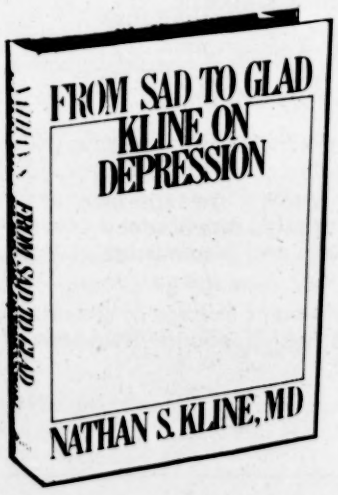
Most doctors would not agree with this, but I don't care, because it's true. Most doctors — and this includes psychodoctors of all kinds, and doctors who in other areas of medicine may be superb — don't know what depression is, don't know how to treat it, and do have a rich fund of bad and mistaken ideas about it. They will waste your time (and here, more than anyplace else you're ever likely to find yourself, time is money), prolong your suffering, tell you things which make you feel guilty and inadequate about the neurosis you don't have, and generally get in your way. All this with the best of intentions and utter innocence as to their utter ignorance.

So how do you find someone? I think the guiding principle is this: the doctors who will be most likely to be effective are those who are involved with the current research. So obviously research outfits are promising. So are large county hospitals. University research facilities and medical schools are the best bet of all, I think. Neighborhood-clinic doctors, who traffic mostly in heartburn and diaper rash, will be much less likely to know what to do with you, more likely to underdose you — which gets no results and will intensify your conviction that there is no hope. Still, it's conceivable that there's a GP down the street who pores every month through the Archives, *absorbing every report of comparison trails of lithium and imipramine.*

The nitty-gritty strategy is to hunt a doctor who has treated at least a dozen depressed patients with antidepressant medication (either tricyclics or MAOI's, or both), and been mostly satisfied with the results. If he doesn't meet this standard, forget him. Take him your flu, if you want, but take your depression to somebody that knows what to do with it.

—Judith Van Slooten

From Sad to Glad: Kline on Depression
Nathan S. Kline, MD
1974; 250pp.
$1.75 postpaid
from:
Ballantine Books, Inc.
457 Hahn Rd.
Westminster, MD 21157
or Whole Earth



True depression. . . requires treatment, and that brings us right back to the question of what kind of illness it is. I am convinced that it's usually a biochemical disorder, and I find that in most cases it responds well to drug therapy. I believe that some cases probably do truly arise from a neurosis, but I consider these to be exceptional instances. I estimate neurotic depression to constitute a very small percentage of the truly severe cases. . . . The really important thing is that in most cases the medication works. . . .

Curiously enough, some patients feel guilty about achieving that kind of recovery. They have been thoroughly indoctrinated in the idea that emotional disturbance must reflect psychic ills, and they expect the treatment to require a prolonged, painful search through deeply buried layers of their unconscious. When they obtain relief without that effort, they feel that they didn't earn recovery because they haven't paid the psychic price. However, that is a disappointment that most can adjust to readily enough.

I recall a particular patient, a prominent radio personality, who was a manic-depressive. For fifteen years he sought a remedy in psychoanalysis, all the while enduring moods that swung erratically and irrationally from elation to despair. "I think the analysis was valuable," he told me later. "I gained a lot of insight into myself. I was probably the most insightful manic-depressive you ever met. But I was still a manic-depressive." I placed him on chemotherapy, and the problem was cleared up in about two months. . . .

The competing biochemical forces are in a constant state of ebb and flow, interacting with one another. When the system is in general balance, the result is the harmony of a well-functioning human brain. An imbalance produces discord. Specifically, we attribute many depressions to amine deficits that damp down the circuits by locking switches in the "off" condition. An amine surplus may produce the opposite manic effects. . . .

For Hawthorne melancholy was like a prison cell, and it was all the more frightening because the bars were invisible. In a letter to his friend Longfellow he described it thus: "I have secluded myself from society; and yet I never meant any such thing. I have made a captive of myself and put me into a dungeon, and now I cannot find the key to let myself out."

It was worse for Dostoevski, becoming at times an ordeal of sheer terror. He described one attack in a letter to his brother:

> As soon as night began to fall, I lapsed into a state which I call *dread*. It is a cruel, unbearable fear in face of something indefinable, something inconceivable, and quite outside the natural order of things . . . [It] comes and dogs me like some inescapable fate, terrible, hideous and implacable it is. This dread becomes stronger and stronger, despite all attempts to reason it away, so that in the end the mind is deprived of every means of fighting against sensation. . . .

One follow-up study on depressive patients done years ago found that one-sixth of them eventually ended as suicides. I would add that the study does not reflect the current advances in treatment. The figure nonetheless underlines the enormous role depression plays. The one-in-six rate compared with a suicide incidence of one in 10,000 among the nation's general population.

It seems probable also that undiagnosed depression is present in many suicides that are not attributed to such. The circumstances surrounding the act quite frequently point to that conclusion.

A Rating of Graduate Programs

If living on an endless treadmill is your ambition, (i.e. defense of thesis, defense of dissertation, fight for a post-doc position, fight for a faculty position, fight for tenure, fight for research grants, fight to publish) then traditional education may be for you.

To get the treadmill started in the right direction you might as well fight your way into a "good" graduate program. This rating of graduate programs is published every 5 years by the American Council On Education. It rates graduate schools in 36 disciplines. Each rating has 3 categories: 1) Quality of Program, 2) Quality of Faculty, 3) and Rate of Change of Program. The third category helps determine if the program is getting better or worse.

—Stephen C. Stem

A Rating of Graduate Programs
Kenneth D. Roose and Charles J. Anderson
1969; 115pp.
$4.00 postpaid

from:
American Council on Education
One Dupont Circle, N.W.
Washington, DC 20036

Barron's Guide to Medical, Dental, and Allied Health Science Careers

Written by a PhD. Tells the odds of being admitted to medical school depending on college grade point average, sex and race. Explains the AMCAS application system. Describes the type of education you'll get in med school. Elaborates on internships plus lists the residency requirements for each specialty. Short blurbs on each school's program including average accepted MCATs. In case you're not admitted, assesses likelihood of foreign study and the likelihood of later parcticing in the US. Assessment for each country. Also treats dentistry. Worth the 4 bucks.

The strong point of this booklet is its section on osteopathic medicine. Osteopathic medicine (as opposed to standard, or allopathic medicine) is not affiliated with the AMA and, as a consequence, is seldom mentioned by the MD authored medical career books. Osteopathic medicine treats the human body as an integrated organism — when one part of the body malfunctions the other parts begin to malfunction, too. Since there are 114 standard medical schools and only 7 osteopathic schools, the AMA will not likely be threatened with competition in services or prices by osteopathy. However, it does represent an alternative.

—Stephen C. Stem

CPC Salary Survey

This publication is kept secret from graduating students. Thus, companies know what salaries to offer graduates but graduates don't know how much to accept.

—Anonymous

CPC Salary Survey
Published three times yearly

from:
College Placement Council
Box 2263
Bethlehem, PA 18001

Initial indications are that 1974-75 is shaping up as a paradoxical year for college recruiting. Although the number of hires is expected to decline, recruiting activity has increased, at least in the early months, according to data compiled by the College Placement Council for its first Salary Survey report of the season. . . .

Although the data are not presented separately by men and women in this report, the number of salary offers reported to women increased by 34% over last year at the bachelor's level and 15% at the master's level. Even with these increases, offers to women made up only 12% of the volume at both levels. No doctoral offers to women were reported. . .

In terms of dollar average of offers at the bachelor's level, the top three curricula were chemical engineering at $1,161 a month, up 11.4% over June (the close of the 1973-74 recruiting season); metallurgical engineering at $1,137, up 13.2%; and mechanical engineering at $1,108, up 10.7%. The 13.2% increase for metallurgical engineering was the largest for bachelor's candidates.

Barron's Guide to Medical, Dental, and Allied Health Science Careers
Dr. Saul Wischnitzer
1974; 146pp.
$3.95 postpaid

from:
Barron's Educational Series, Inc.
113 Crossways Park Drive
Woodbury, NY 11797

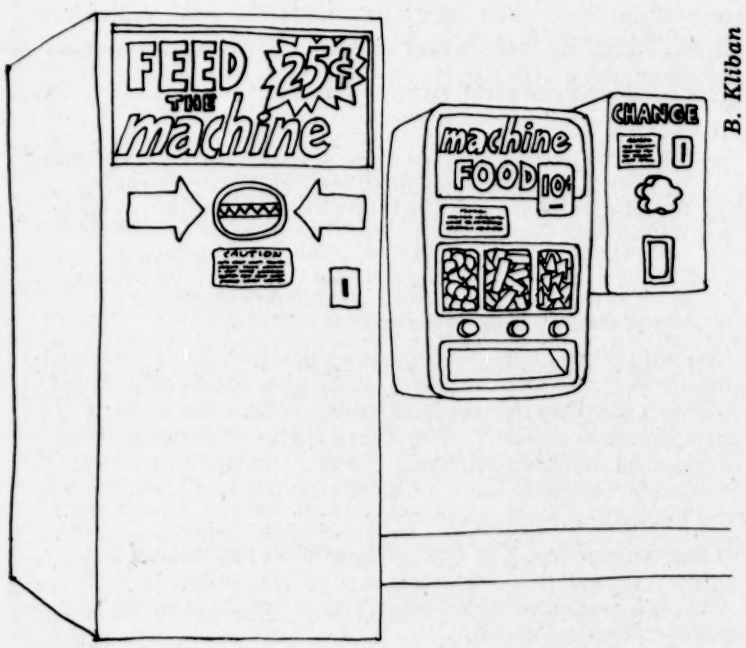
. . . the majority of osteopaths are general practitioners . . . found in small communities where there is a special need for family physicians and general practitioners. The income for osteopathic physicians is comparable to that of conventional doctors and depends on location.

•

Grade point average of the entering osteopathic class was 2.87/4.00 (which is lower than that of standard medical schools).

•

Average age of the entering osteopathic class was 25 years (which is older than that of standard medical schools).



B. Kliban

More on Grassroots Distribution

In the Spring 1975 CoEvolution Quarterly we invited any of you who know of newsstands or bookstores in your area that might be interested in carrying the CQ to become one of our distributors. That invitation still stands.

For those of you who'd like to order in case lots (a case is 75 copies), we'll ship you the current edition of the CQ for $1.25 per copy. The suggested price to retailers is $1.50 per copy. We'll give you full credit for copies returned to us in saleable condition. (Please send full payment with your order.)

There is another option for small bookstores or shops that might want to carry the CQ but can't handle orders of a case lot or more. For them, our terms are these: a minimum order of 10 copies for $1.50 per copy, with no returns and with pre-payment in full. If you think your corner grocery, for example, might be interested, show them a CQ. We could sure use the exposure.

Our vision is still the same: to participate in a national distribution network that could reach shops not being served by the current distribution networks. And it seems to us that you, the people who know us best, could be our best distributors. If you're interested, contact me at Box 428, Sausalito, CA 94965. Phone (415) 332-1716.

—Jeanne Campbell

CoEvolution Quarterly - Spring 1976

Expenses		
Salaries and Fees		
Office	$ 7,680	
Production	3,160	
Editorial & Contributors	6,290	
Rent & Utilities	1,800	
Office Supplies	770	
Production Supplies	1,830	
Postage (office)	380	
Phone	820	
Auto & Travel	350	
Research	170	
Misc.	50	
Total Production Expenses		$23,300
Printing (25,000 copies)		13,500
Promotion		2,500
TOTAL EXPENSES (Exclusive of distribution)		$39,300

Income		
Subscriber copies		
Subscription price	$ 1.50	
Business reply mail	(.045)	
Computer records	(.066)	
Labelling & sorting	(.038)	
Postage	(.063)	
Net return per copy	$ 1.288	
10,500 copies		$13,520
Newsstand copies		
Cover price	$ 2.50	
Wholesale discount	(1.25)	
Shipping	(.063)	
Returns (20%)	(.25)	
Net return per copy	$ .937	
10,500 copies (shipped)		$ 9,840
TOTAL INCOME		$23,360
NET LOSS		$15,940

CQ financial picture

Stewart:

Here's the clearest state-of-the-publication report I can come up with. The production expenses are our actual expenses from 11/1/75 to 1/31/76. The printing and promotion figures are estimates of what we will spend for this issue. The income side shows the net return to us for subscriber and newsstand copies. Since we always have to ship more copies to newsstands than we finally sell, it seems better to figure in the returns rate and calculate based on the number shipped. (It looks like the returns rate for the Fall '75 issue might be as low as 11%.)

The one additional figure to keep in mind is the incremental cost of printing additional copies of the magazine. Including inserts, increasing our print run should cost us about $ .40 per copy. Each additional subscriber copy therefore nets us $ .888. So if we're to make up the $15,940 loss, and we keep on shipping about 10,500 copies to newsstands, we need an additional 17,950 subscribers.

How did the 18,000 "magic number" suddenly become 28,000? For a start, our production expenses are now $6,000 higher than when we last figured. That's 6,750 subscribers right there. Postal rate increases and the cost of keeping our subscribers serviced have also cut our return per subscriber copy by 13%. That's another 2,300 or so subscribers we need. And we're having to spend money to find those subscribers. The $750 increase in our promotion budget over the one we figured last Fall means another 850 subscribers. Just those three items pretty much account for the difference.

What should we do about it? The amazing jump in our total number of subscribers (from 5000 to 8,500 in three months) kept our bank account from dwindling too drastically this past quarter, but can we really hope to survive based on the very growth-reliant model that we know leads to a house of cards? Maybe we'll have no alternative but to follow Jeanne's thought and raise the subscription price. (At $8/year, we'd only need about 21,000 subscribers as opposed to 28,000.)

Just so we don't get too locked in to a new magic number, we've got to realize that more subscribers will mean more people/hours to serve them. (Andrea and I have decided to keep track of office salaries separately.) And Bob Parks tells me that the cost of newsprint will be increasing 9% in April.

Somehow, I couldn't bring myself to do another "keep-those-cards-and-letters-coming-in-folks" report. Maybe we should just let the numbers speak for themselves this time.

—Andrew Fluegelman

Dear Andrew:

Thank you for a quick pin in our balloon. We had gotten a bit euphoric over the improvement in our short-term financial picture (only $3,600 loss during Nov-Jan, versus the $14,000 loss during Aug-Oct '75). As you know, we owe that improvement to the continuing crowd of new subscribers (300/week) brought in by the readership.

That, along with the news that sales of the 16th (and 17th) edition of The Last Whole Earth Catalog *has completely paid off our debt to Viking-Penguin, means that we're no longer in immediate dire straits. But we're chasing our own growth, just like certain governments we know. Each subscription is a loan that, by the time we've fulfilled it with four* CQ*'s, hasn't made us anything and may have cost us. The entire $25,000 we're getting from* Catalog *sales is disappearing into the April printing of the next (the 19th) edition of 25,000 new* Catalogs. *Quite reasonably* Catalog *and* Epilog *sales are dropping slowly and steadily. They will not support us in our old age.*

It looks to me that financial responsibility is going to require a higher subscription rate, $8/yr by this summer. That way we might see per-quarter black ink by fall, and per-issue black ink by next year. The magazine might even improve by a third to match the new price, or maybe those readers who complain we've been undercharging are right. That's a complaint I'd like to keep earning.

—Stewart Brand

Subscription price going up

As of June 21, 1976, the subscription price of The CQ will go up to $8/year. Until then the $6/year price holds. Gift subscriptions, renewals, two-year subscriptions ($12), and subscription extensions received before June 21 will be honored at the $6 rate.

Or Whole Earth

Under the access of an item in The CQ *means you can mail order it from:*

Whole Earth Truck Store
558 Santa Cruz Ave.
Menlo Park, CA 94025

Anything else — letters, material for the magazine, subscriptions, complaints, should be sent to us here at:

The CoEvolution Quarterly
Box 428
Sausalito, CA 94965

Gossip

Pam Cokeley was hired away from us for the glamorous life of handling West Coast publicity for Alfred A. Knopf, Inc. She comes around for volleyball and proofreading, and is missed.

One noon while executing a sideways spike at the volleyball net Evelyn Eldridge shattered her left ankle. Jeanne Campbell wrote on the cast, "This is pretty lame."

This fall Dan O'Neill was given the highest award a cartoonist can receive by the 11th International Congress of Cartoonists and Animators at Lucca, Italy. Two thousand cartoonists saw him accept the astoundingly ugly statuette called "The Yellow Kid" (the name of an 1890's strip by Outcault, who invented the speech balloon.)

J.D. Smith and Jeanne Campbell brought new faces and subjects to the Winter CQ *while I took a much-needed break. It turned out to be mostly a Vacation-in-Place, which I now heartily recommend to all. You tell everyone you're going away for a month. You leave. You come back after a week and return to your desk and tend only to interesting minor tasks, being sure to purge finally all the old backed-up piles. You arrive at work late, leave early or whenever you feel like it, and learn what your home is like during the day. All the old errands there also get done — a novel experience. When a Vacation-in-Place is over, you're rested, interested in working, and have a fresh grip obtainable in no other way.*

This issue of The CQ *seems okay. It's got too much of my name. We are that personal but we aren't that monolithic. Here's OUR vote on Space Colonies: J.D., no . . . J. Baldwin, yes . . . Mike, no opinion . . . Evelyn, undecided . . . Peter Warshall, no . . . Andrew Fluegelman, yes . . . Andrew Main, no now, yes later . . . Pam, no . . . Carol Kramer (in the distance), yes . . . Jeanne, yes . . . Diana, yes (converted by Schweickart) . . . Andrea, no. . . .*

—SB

Thank you:

Maniacal Subscriber ($1000)

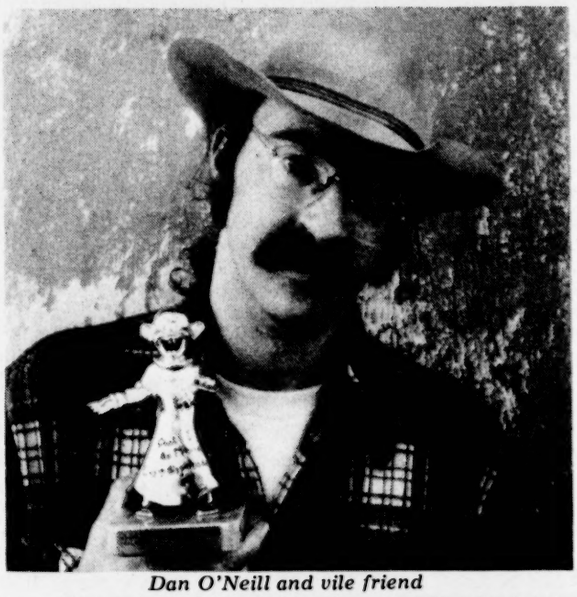
Gurney Norman
Menlo Park, California

Sustaining Subscribers ($100)

Roy Rappaport
Ann Arbor, Michigan
Audrey Sabol
Villanova, Pennsylvania
Ray Lefebvre
Baton Rouge, Louisiana
Edmund G. Brown, Jr.*
Sacramento, California
William Ryder
Miami, Florida
Marlon Brando*
Beverly Hills, California
Kay S. Bogart
Corvallis, Oregon
Julia Brand
Rockford, Illinois
Jean C. Taupin
Pescadero, California
[*By virtue of returning payment for interview]

Retaining Subscribers ($25)

Warren Van Camp
Mountain View, CA
Paul Manuel Baker
Williamsburg, VA
W. Duane Gambee
Pontiac, MI
Brad Fackler
Plymouth, IN
David Deppen
Philadelphia, PA
David Caulkins
Los Altos, CA
Edward Rosenfeld
New York, NY
Mike Drahota
Stanton, NE
Burhl Gilpin
Grand Island, NE
Patrick Grealy
Houston, TX
June Hiatt
San Juan, PR
James M. Knight
Shreveport, LA
Glenn Koenig
Arlington, MA
Ken Morgan
Kemmerer, WY
Steven A. Mink
Dundee, IL
Mitchell J. McCann
Tallahassee, FL
Eugene Rodriguez
St. Louis, MO
Peter Schwartz
Palo Alto, CA
Rich Seidner
Los Gatos, CA
Timothy Wilson
New York, NY
Nathan Hare
San Francisco, CA
Pamela Sanderson
Boulder, CO
Robert L. Payton
Hempstead, NY
Paul L. Brandon
San Jose, CA
Tim Coiner
Hansen, ID
Ecotope Group
Snohomish, WA
Marlin Prowell
Bellingham, WA
J. Levi Hanson
Westfield, NC
April Funcke
San Francisco, CA
Bruce & Barbara Kantner
Phillips, ME
Lee Bonnifield
Durham, NC
Miles Merwin
Davis, CA
Daniel Underwood
Columbus, OH
Bruce Umbarger
Lansing, MI
R.F. Radke
Milwaukee, WI
Rob Potter
Seattle, WA
Guy Pignolet
Reunion, Indian Ocean
Dana McCannel
Jordan, MN
D. Miller
Willingboro, NJ
Douglas Kerr
Alameda, CA
M. Krepner
Spruce Grove, WV
Gene Mahon
Nantucket, MA
Carol Anderson
Sheridan, OR
Philip M. Bainey
Alaha, OR



Dan O'Neill and vile friend

The CoEVOLUTION Quarterly

Editor Stewart Brand

Research Traffic & Accounting Andrea Sharp

Office Maintenance J.D. Smith

Production Manager & Paste-up Diana Fairbanks

Distribution, Promotion, & Library Jeanne Campbell

Subscriptions & Backorders Michael Young

Typesetting Evelyn Eldridge

Camera, Paste-up & Printing Liaison Andrew Main

Soft Tech, Shelter, & Nomadics evaluations J. Baldwin

Land Use evaluations Peter Warshall, Rosemary Menninger, Richard Nilsen

Craft evaluations Diana Sloat

Learning evaluations George Cope

Personal Computer section Marc Le Brun

Proofreader Pam Cokeley

Illustrations G. Russ Youngreen, Philip Garner, Jay Kinney, Anne Norcia, Larry Todd, Arthur Okamura

Mailing services Mailing Management, San Francisco, CA

Printing (body) Fricke-Parks Press, Fremont, CA
(cover) Hatcher Trade Press, San Carlos, CA

T. Winsberg
Boynton Beach, FL
John Schaeffer
Elk, CA
Donley Smith
San Francisco, CA
E. F. Deegan
Philadelphia, PA
Richard Chlopan
Ann Arbor, MI
Karl Stalnaker
Lilburn, GA
W. A. Williams
Waldport, OR
Alex Spear
Pasadena, CA
Virginia & Palmer Madden
Alamo, CA
Erik Graffman
Stockholm, Sweden
Ian Ballantine
Bearsville, NY
C.H. Richards
Cupertino, CA
Andre Papantonis
Baltimore, MD
Dave Gallagher
Springfield, PA
Bradford Liff
Pittsburgh, PA
Dennis M. Bierlein
Frankenmuth, MI
Rolf & Maarja Evenson
Minneapolis, MN
Keith Ball
Gary, IN
Martha Freebairn-Smith
Mill Valley, CA
Curt Braden
Southeast, MI
Janet & Merrill Bickford
Pescadero, CA
John McCord
Chicago, IL
Norman Pease
Orinda, CA
Donald Cooke
Corinth, VT
James Dayton
New Park, PA
Gene Duncan
Palo Alto, CA
Noel Farmer
Toluca Lake, CA
Vernon M. John
Los Altos, CA
Tim & Mona Bayard
Wilmington, DE
Richard L. Allen
Kailua, HI
Wm. Delafield
Bryn Mawr, PA
Jerry Sievers
Vincennes, IN
Microsculptor
Berkeley, CA
And 8 Anonymice

FIRST CLASS
PERMIT NO. 103
SAUSALITO, CA

BUSINESS REPLY MAIL
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

POSTAGE WILL BE PAID BY

The CoEVOLUTION Quarterly

P. O. Box 428
Sausalito, California 94965

Sender's address:

NAME

ZIP

Subscription Form

☐ $6 Please send me a year's subscription to **The CoEvolution Quarterly** starting with ☐ Spring 1976 ☐ Summer 1976.

☐ $25 I would like to be a Retaining Subscriber.
☐ $100 I would like to be a Sustaining Subscriber.
☐ $1000 I would like to be a Maniacal Subscriber.

_____

_____

_____

Zip 6093

☐ Please send ____ gift subscriptions ($6 each) to friends listed on the enclosed Gift Announcements.

I would also like to receive:
☐ the following back issues ($1.50 each)

_____

☐ *The (updated) Last Whole Earth Catalog* ($6)
☐ *Whole Earth Epilog* ($4)

$ _____
total enclosed

The CoEvolution Quarterly
Box 428
Sausalito, California 94965

Gift Announcement

CoEvolution Quarterly, Box 428, Sausalito, CA 94965

To: _____

_____

_____

Zip 6094

Dear _____

I'm sending you a year's subscription to **The CoEvolution Quarterly** . . .

Signed _____

Gift Announcement

CoEvolution Quarterly, Box 428, Sausalito, CA 94965

To: _____

_____

_____

Zip 6094

Dear _____

I'm sending you a year's subscription to **The CoEvolution Quarterly** . . .

Signed _____

Gift Announcement

CoEvolution Quarterly, Box 428, Sausalito, CA 94965

To: _____

_____

_____

Zip 6094

Dear _____

I'm sending you a year's subscription to **The CoEvolution Quarterly** . . .

Signed _____

Gift Announcement

CoEvolution Quarterly, Box 428, Sausalito, CA 94965

To: _____

_____

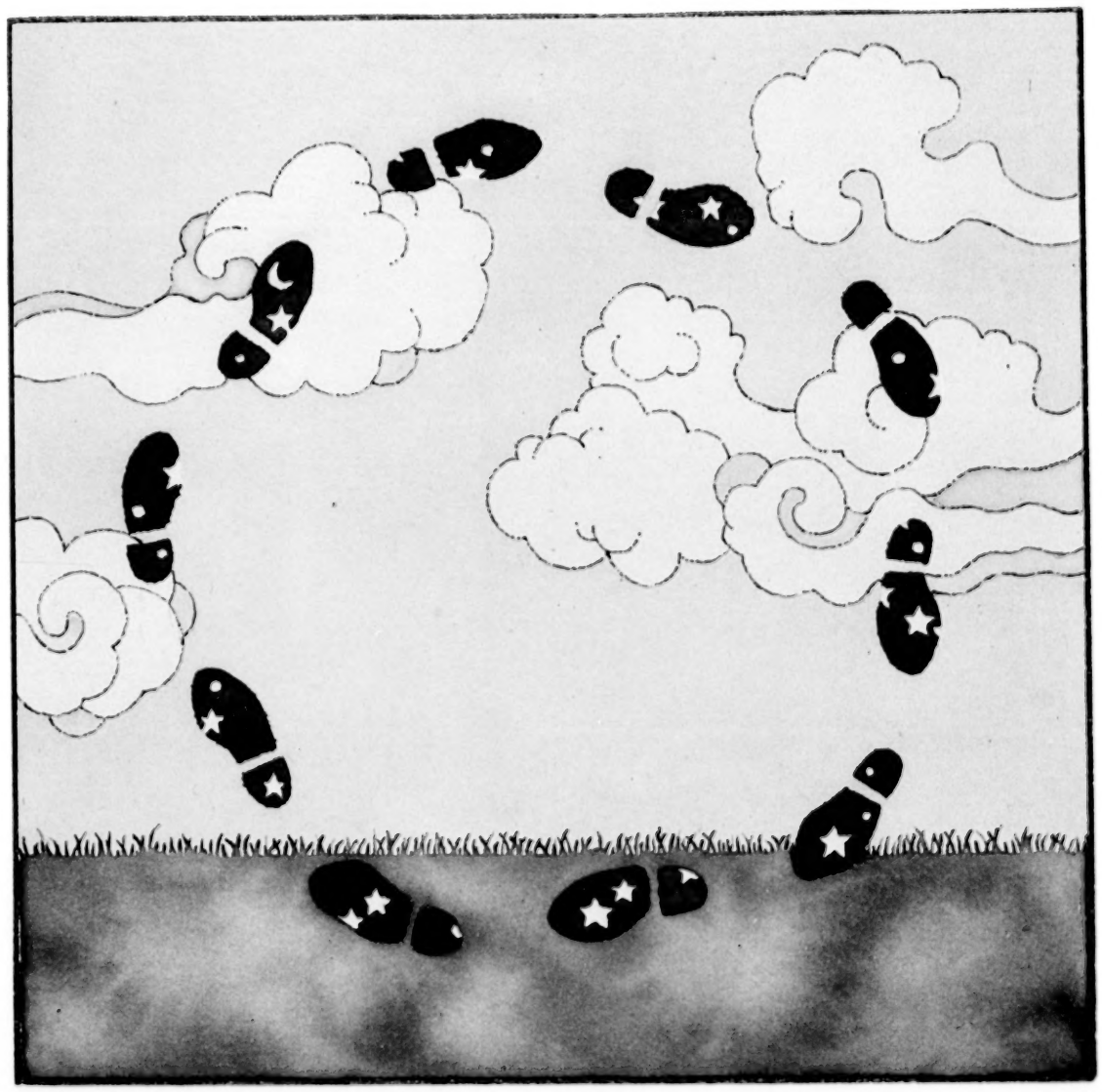
_____

Zip 6094

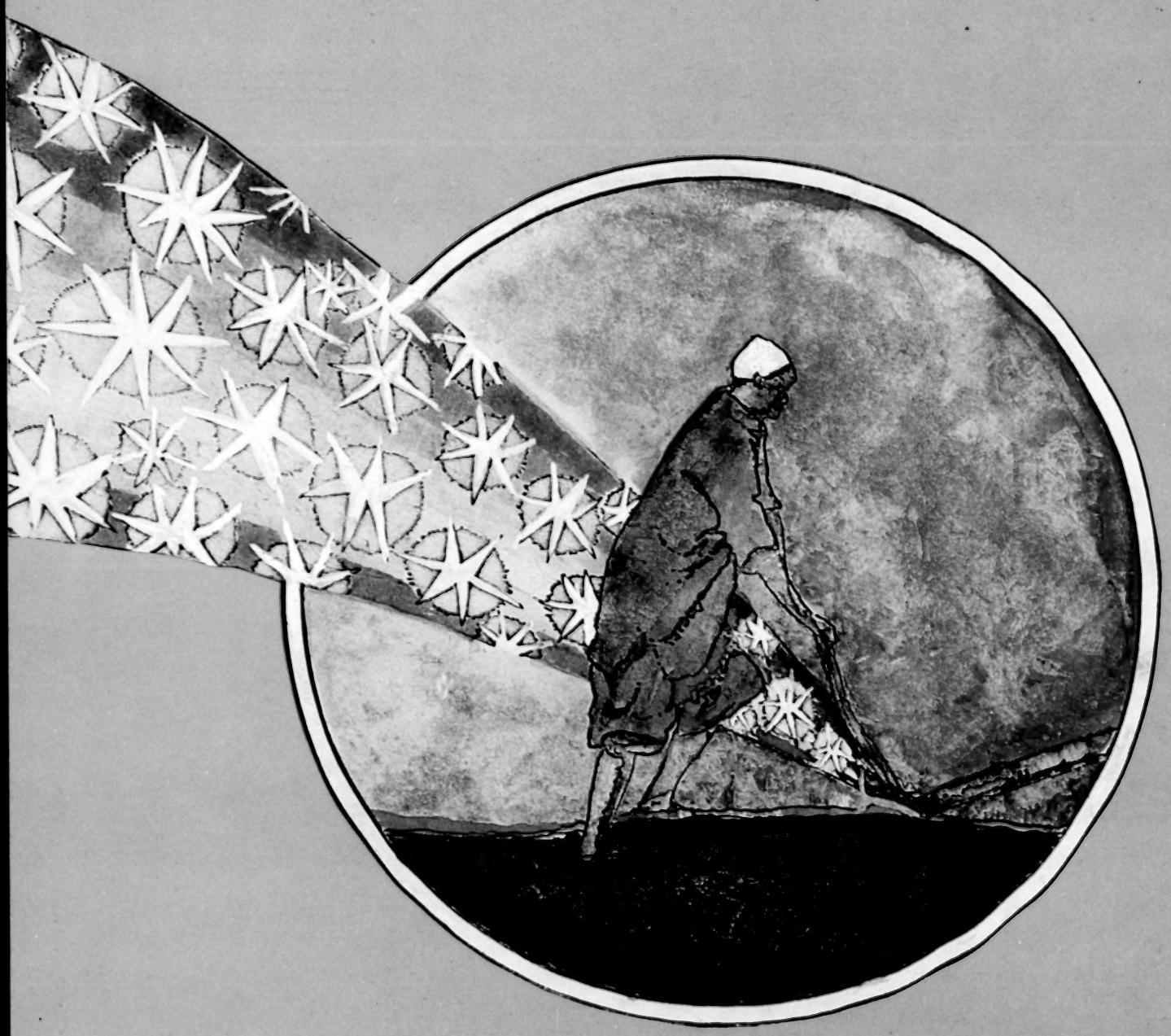
Dear _____

I'm sending you a year's subscription to **The CoEvolution Quarterly** . . .

Signed _____



Watercolor by Frank Olinsky, Brooklyn, NY



SPRING EQUINOX
1976